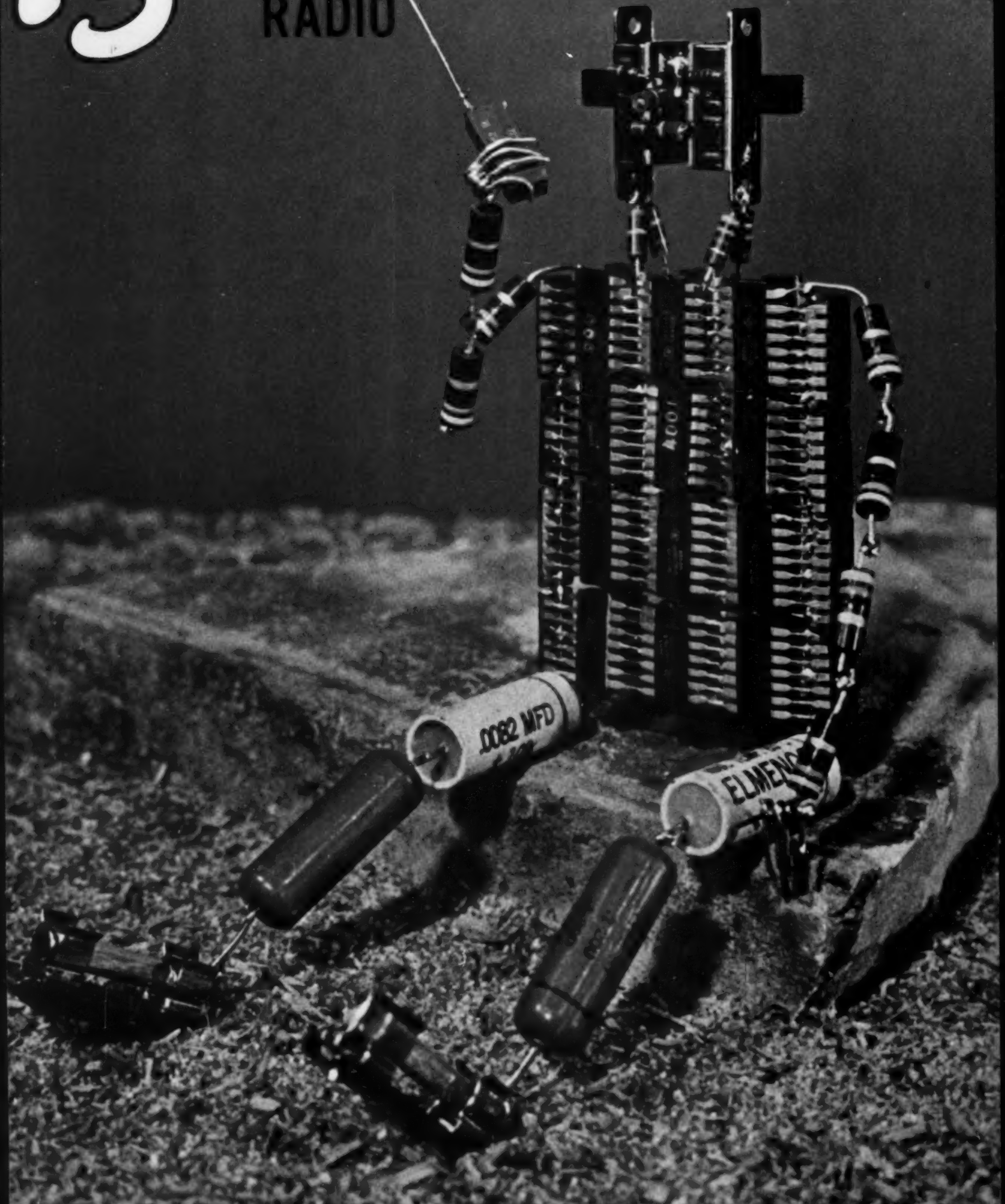
73 AMATEUR RADIO

JULY 1977
$2.00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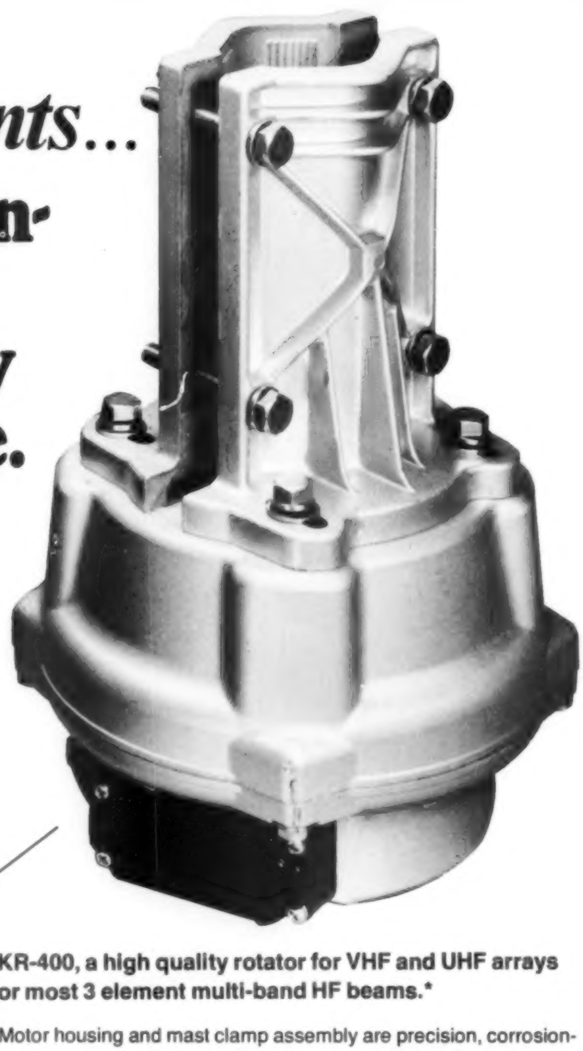

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- Supports 400 lbs (181 KG) vertical weight.
- Accommodates masts 1.5 to 2.5 inches in diameter (38 to 63.5 mm).
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- Shipping weight: 18 lbs (8.16 KG).
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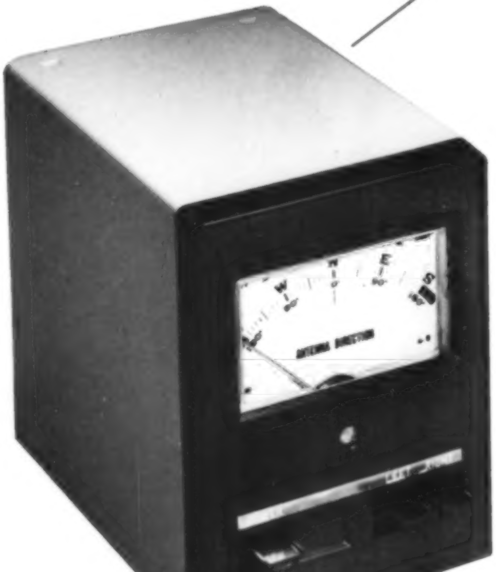

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Introducing the IC-245, 144-148 MHz FM Transceiver

The VFO Revolution goes mobile with the unique, ICOM developed LSI synthesizer with 4 digit LED readout. The **IC-245** offers the most for mobile on the market. The easy to use tuning knob moves accurately over 50 detent steps and assures excellent control as easily as steering the vehicle. With its optional adapter, the **IC-245** puts you into all mode operation on 12V DC power with a compact dash-mounted transceiver. In FM, the synthesizer command frequency is displayed in 5 KHz steps from 146 to 148 MHz, and with the side band adapter the step rate drops to 100Hz from 144 to 146 MHz. For maximum repeater flexibility, the transmit and receive frequencies are independently programable on any separation. The **IC-245** even comes equipped with a multiple pin Molex connector for remote control.

The **IC-245** is a product of the revolution in VFO design, from its new style front panel, to its excellent mechanical rigidity and Large Scale Integrated Circuitry. Your **IC-245** will give you the most for mobile.

SPECIFICATIONS

GENERAL	
Frequency Coverage	***144.00 to 148.00 MHz**
Modes	**FM (F3)** ***SSB (A3J), CW (A1)**
Supply Voltage	**DC 13.8V ±15%**
Size (mm)	**90H x 155W x 235D**
Weight (kg)	**2.7**
TRANSMITTER	
TX Output	**F3 10W** ***A3J 10W (PEP), A1 10W**
Carrier Suppression	**40 dB or better**
Spurious Radiation	**−60 dB or less below carrier**
Maximum Frequency Deviation	**±5 KHz**
Microphone Impedance	**600 ohms**
RECEIVER:	
Sensitivity	***A3J, A1 0.5 microvolt input gives 10 dB S+N/N or better F3 0.6 microvolt or less for 20 dB quieting S+N+D/N at 1 microvolt input, 30 dB**
Squelch Threshold	**−8 dB or less (F3)**
Spurious Response	**−60 dB or better**
SYNTHESIZER:	
Frequency Range	**144 MHz to 148 MHz**
Step Size	**5 KHz for FM** ***100 Hz or 5 KHz for SSB**
Stability	**per C in the range of −10 to +60 C, ±0.0000145% per C**

*** Valid with SSB Adapter only**

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NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

WHEN THE JAMMER HITS

One of these days, unless the laws of chance have been repealed, your repeater is going to be the target of a persistent kerchunker or even a dedicated jammer, complete with a four letter vocabulary which would be more fitting to the current run of movies than to amateur radio. Outside of panic, what should you do?

The first thing, obviously, is to make some tapes and get together with the FCC. Horsepucky. Leave the FCC alone — they are not anxious to hear from you and would prefer not to be bothered. No, the first thing to do is give a big yawn and try to get some sleep. If, after a few days, the chap shows better than average stamina and keeps on messing things up, despite every effort of the repeater users to totally ignore him, then it's time to swing vigorously into phase two . . . a little longer nap, possibly with a dash of television viewing to break the monotony.

Okay. I can see you are determined to let this bugger get under your skin and you want action and you want it right now. Well, sigh, how about making up a couple of direction-finding loops and learning how to use them? Yes, I know the FCC can do this, but they are busy. Do it yourself and learn something. Two fellows with direction-finders can get a good idea of where the miseries are originating, and you can close in. Once you've located the jerk, you have to figure what to do about him. No, you can't do that.

Look on the bright side . . . fox hunting is a lot of fun and the exercise will be excellent for the club. The fact is that your club should be ready for this and have some practice before the fan gets hit. Get some transmitter hunts organized so the equipment will be ready to use and a few of the fellows will know how to use it.

The FCC has some direction-finding (DF) equipment which will give the bearing of a transmitter within a second. Now that amateurs have discovered microcomputers, perhaps it is time that we developed some of the same hardware. You can bet that the pages of *73* are open to any good DF articles and will make it worthwhile for fellows who dream up some good DF techniques.

One technique, which I've mentioned before, but of which little has been written, is one which examines the leading or trailing edge of a transmitter's carrier and puts it on a scope. My understanding is that every transmitter is a little bit different . . . that each rig has its own kerchunkprint. This means that when someone tries to transmit without his call, you can check out his kerchunkprint and compare that with some later time when he is just using the repeater to talk and gives his call.

Let's get busy with fox hunting circuits and apply some digital techniques to them which will make instant DF possible. And let's not forget to write it up!

NEW ORLEANS HAMFEST/COMPUTERFEST

The 1976 show came off so well that the New Orleans group has gotten bigger digs for this year. It's going to be at the Hilton Inn in Kenner this year, right across from the New Orleans International Airport. The dates are September 24-25th. Info can be had by writing box 10111, Jefferson LA 70181. Unfortunately, this is the same weekend as a hamfest in Hartford, so I'll have to miss New Orleans . . . perhaps the dates will not coincide next year . . . New Orleans is quite an attraction and I hate to miss it.

MAKE A MILLION

Forgive my enthusiasm, but every now and then a brilliant idea comes along and gets me all excited. Perhaps someone reading this magazine is looking around for an idea for a product which will sell like crazy, which wouldn't be very expensive to make, and which just about everyone needs. I have such a product in mind. It's so simple I don't know why it isn't available.

The chances are good that you are a coffee drinker . . . or at least tea? You may just drink it at dinner, but you are probably more like the rest of us in that you have several cups through the day. Most businessmen have coffee every now and then to keep the wheels churning. And how many of you don't have a mug on the operating desk with an inch of cold coffee in it?

Cold coffee . . . that's what did it to me. I was deep in a contact with a friend in Spain and I absentmindedly picked up my cup and took a swig of cold coffee. Iced coffee is something else . . . I can drink that, but cold coffee is an abomination and I came to my senses with a shock as the vile stuff hit my taste buds.

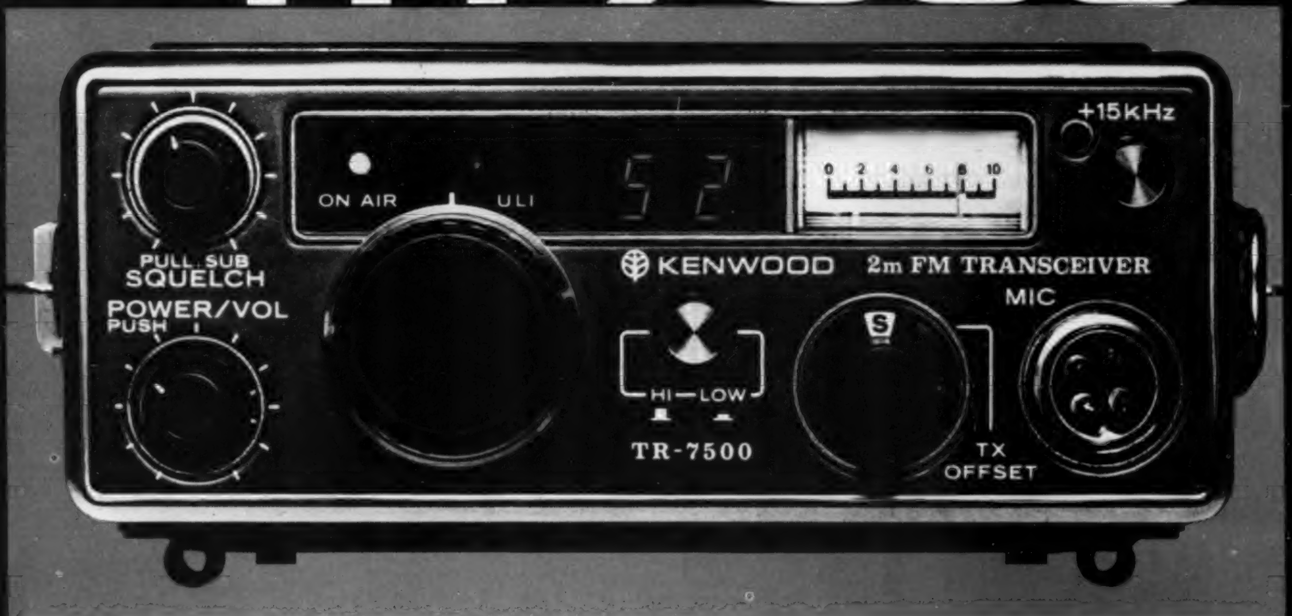
Someone is going to design a simple mug with a heater and thermostat built in to keep coffee warm. It can sit in a holder with the power transformer built in, making contact when you put the cup down . . . something like the rechargeable soldering irons, only without batteries. The electrical contact shoes can be built into the bottom of the mug and the mating spring contact in the holder. Will you

Continued on page 174

MAKE A REAL DEAL
ON AN ICOM
K

The New Orleans Hamfest/Computerfest.

TR-7500



There are a number of good 2 meter FM transceivers on the market. You may already own one. But, even if you do, we suggest that you put your radio to this test. And, if you're thinking of buying one, this test should be a helpful guide.

	NO	YES
Is it PLL synthesized?	☐	☐
Does it have 100 channels (88 pre-programmed)?	☐	☐
Does it have 12 extra diode programmable channels?	☐	☐
Does it have single knob channel selection?	☐	☐
Does it have a LED digital frequency display?	☐	☐
Dos it have a powered tone pad connection?	☐	☐
Does the receiver have helical resonators?	☐	☐

If your answer is NO to any of these, the TR-7500 is the radio that you should own. And, in addition to these important features, you get proven Kenwood quality, value and service.

TR-7500 Specifications

Semiconductors:	Transistors	41
	FETs	8
	ICs	7
	Diodes	35

Frequency Range: 146.01 to 147.99 MHz
Mode: FM
No. of Channels: 100
Operating Temperature: −20 to +50 degrees C
Power Voltage: 11.5 to 16.0V DC (13.8V DC nominal)
Grounding Polarity: Negative ground
Antenna Impedance: 50 Ohms
Current drain: Less than 0.5A in receive with no input signal Less than 3A in transmit (HI) Less than 1.5A in transmit (LOW) (at 13.8V DC)
Dimensions: 172 mm (6—3/4") wide
250 mm (9—7/8") deep
75 mm (2—15/16") high
Weight: Approximately 2.2 kg (4.8 lbs.)

TRANSMIT SECTION

RF Output Power: High: 10 Watts
Low: 1 Watt (approximately)
Modulation: Variable reactance frequency shift
Frequency Deviation: ±5 KHz
Spurious Radiation: Better than −60dB
Tone Pad Input Impedance: 600 Ohms
Microphone: Dynamic microphone with PTT switch, 500 Ohms

RECEIVE SECTION

Receive System: Double conversion superheterodyne
Intermediate Frequency: 1st IF: 10.7 MHz
2nd IF: 455 kHz
Sensitivity: Better than 0.4 uV for 20dB quieting Better than 1 uV for 30dB S/N
Squelch Sensitivity: Better than 0.25 uV
Selectivity: 12kHz at −6dB down
40 kHz at −70dB down
Image Rejection: Better than −70dB
Spurious Interference: Better than −60dB
Audio Output: More than 1.5 watts across 8 Ohms load 10% distortion
Intermodulation: Better than 66dB

TRIO-KENWOOD COMMUNICATIONS INC. 1111 WEST WALNUT/COMPTON, CA 90220

KENWOOD
. . . pacesetter in amateur radio

Briefs

Compiled by Warren Elly WA1GUD

Got a good ham radio news story? Drop us a line, or call it in, and take home the 73 publication of your choice, provided we publish your news tip. Be sure to specify which book you want. OK?

It seems that "confidential document" Jack Anderson referred to in his national attack on ham radio (see *73* for June) came from the Electronics Industries Association (EIA). Southwest ARRL director John Griggs had quite a bit to say both about the EIA and Anderson during a talk at the Poinsettia ARC in California.

Anderson himself backed down a bit in his column published during the week of April 25th, claiming he never intended to attack hams. "We merely pointed out," Anderson wrote, "that the airwaves belong to the public, that there are far more citizens using CBs than ham equipment and that some of the federal regulators were hams." Anderson extensively quoted Senator Barry Goldwater K7UGA in the follow-up column, reprinted here from the *Washington Post*. "Goldwater complained that the CB enthusiasts often operate without a license and amplify their transmitters beyond the 5 Watt limit. They have also abused the system, he charged, in complete objection to all concepts of decency and gentlemanliness on the air. While this doesn't apply across the board, there are enough offenders that, I don't care how many frequencies they have, they are slowly going to destroy their own function. Many of these CBers never use their callsigns or their names. There are many who use profanity and what they discuss should never be carried on any airwaves. In many cities, prostitutes use these frequencies to solicit business, and I could go on and on." Concluded the senator, "I think I can safely say, Jack, that the amateurs throughout the years have contributed more to the art of communications than all of the so-called experts in the field. Our frequencies have been diminishing, not increasing. We have great pride in our craft."

Shortly after the second Anderson column appeared, an ARRL official told *73* that the Anderson situation was "under control." He went on to say that the author of the original story was now taking a Novice license course and was greatly interested in ham radio. We were unable to confirm that through a call to Anderson's Washington office, but we did learn that the original column had already been added to the EIA's battery of handouts promoting additional frequencies for CB. Official ARRL reaction to the Anderson mess came in two steps during late April. First, a directive to all League officials to "stand by" while headquarters found out how the column was written in the first place. Then, two weeks later, word came that the League has taken a strong step to offset the bad PR . . . a new award for any amateur whose response to the Anderson column was published or publicized. It's called the "Amateur Radio Promotion" award and is available only to League members.

Dayton
HAMVENTION
HAMVENTION
26th
1977

Dayton's official attendance figure came in at 16,290, according to Dayton Amateur Radio Club officials. Well over 1,500 attended the Saturday night banquet, which featured NBC correspondent Roy Neal K6DUE, and a Special Event Achievement Award to the Pack Rat's Colombian EME DXpedition as HK1TL. At the AMSAT seminar, W8DX won a Special Communications Recognition Certificate for his long service to the OSCAR program. At the ARRL forum, President Harry Dannals W2HD raised a few eyebrows with news that the League may send a representative to Washington (this on the heels of similar discussions at a meeting of ARMA, the manufacturer's association). The League is apparently changing its long controversial stand that General Counsel Robert Booth, based in Washington, was all the representation that the ARRL needed in the capital. ARMA meanwhile voted to put the question of a Washington lobbyist to a committee, with a report upcoming at a future meeting.

A federal grand jury has indicted the head of the FCC's Gettysburg Special Licensing Division on bribery charges. According to a US Attorney connected with the case, Richard C. Zeigler's indictment was the result of an FBI investigation conducted in several US cities over a three month period. Zeigler is accused in the indictment of accepting four separate $100 bribes from amateurs seeking 1 x 2 (two letter) callsigns. US Attorney David Queen refused to name the amateurs, or comment beyond the indictment, but it was learned that Zeigler pleaded not guilty at his arraignment and posted $5000 bail. If convicted, Zeigler could receive 15 years in prison and $25,000 in fines *for each of the four* alleged violations. Zeigler's trial was expected to get underway in early June. Zeigler himself could not be reached for comment, and officials in the FCC's Personal Radio Division in Washington refused comment.

The Japanese government subsidizes the Japanese electronics industry — that was the ruling of a US Customs Court in mid-April, and it may have far-reaching implications for amateur gear (not to mention automobiles, TV sets, and hi-fi equipment). By court order the US government was told to raise import duties on Japanese imports, but, with billions of dollars at stake (not to mention the balance of payments situation), the appeals from Japanese interests are expected to tie up the case for years, if not kill it outright. An American TV manufacturer brought the court case, but business observers are not exactly "bullish" on its implications — since Japan (and other countries likely to be affected) are certain to retaliate with higher duty on American products, should the court order withstand the appeals.

No sign of the licensing boom slowing down . . . Gettysburg reports another record month in March, with the amateur population passing the 300,000 mark for the first time ever! Amateurs, then, have increased their numbers by over 35,000 in the last 12 months. Indications are that the growth will continue, with 350,000 licensees expected on the FCC computer by 1978.

CW comprehension exams should be in effect everywhere by the time this issue of *73* reaches you. The long delay in start-up was blamed on contract problems with contractors paid to produce the tapes and duplicates for each field office. FCC officials say test runs of the exams in

By Saturday afternoon the Hara was adrift in a sea of cars. For miles in every direction latecomers parked along the highways. Those lucky enough to make it through the 3-hour traffic jam gladly paid their parking fees.

the Washington DC office showed an 80 percent pass rate, compared to less than 50 percent for the old exams. Several who had taken the comp exams told us in Dayton that the new tests were actually harder . . . but FCC spokesmen countered that it was probably just their reaction to a new way of doing things.

The Illinois Attorney General's probe into the activities of Irael Treger (Trigger Electronics) has taken another turn . . . at deadline Treger was being held on $25,000 bond in the Cook County Jail. According to Deputy AG John McPhee, evidence was presented to the judge in Treger's consumer fraud case that Treger was planning to leave Illinois. On a writ of no exeat, Treger was arrested by local police. He was ill at the time of his arrest, and was taken first to Cook County Hospital. Treger, unable to post the bond, was then transferred to the County Jail Hospital. McPhee continues to process the fraud complaints against Treger, which reportedly amount to between $15,000 and $20,000. Trigger Electronics has been closed for some weeks now, after the landlord evicted Treger for failure to pay his rent. The eviction followed a court injunction barring Trigger from mailing catalogs or advertising, after the IL AG's office presented evidence that alleged the company was taking orders without inventory, and refusing to make refunds.

The president of H. F. International, John Randall, has refused to testify in an FCC hearing called to revoke his CB license. According to an FCC spokesperson, Randall was one of 21 HFers ordered to show cause why their CB licenses should not be revoked due to their involvement in HF International, an organization of pseudohams operating between 11 and 10 meters with amateur equipment, high power, and big antennas. Known as "Jack HF 61," Randall was charged with various violations of the FCC rules and Communications Act of 1934. The FCC alleged he had assigned call letters to CB operators for use instead of their FCC callsigns, that he had allegedly formulated rules instructing the unlicensed pseudohams to operate illegally on frequencies assigned to the Industrial and Business Radio services. The FCC notice also contended that Randall had published and sold lists which contained HF numbers, first names, and states of the pseudohams, thus avoiding FCC identification of their CB calls or locations. Randall refused to answer any of the FCC's questions, taking the 5th amendment instead. "Applicant therefore respectfully asserts his privilege against self-incrimination and his privilege not to give evidence against himself as set forth in the Constitution of the US and in particular the 5th Amendment thereto." Hearing Judge Walter C. Miller allowed Randall his right to remain silent, but added that a determination would come whether Randall had abused the Commission's rules by refusing to answer. In other words, Judge Miller would get his answers when the case reached the hearing stage. But before that could happen, Randall withdrew his application for renewal of his CB license. FCC officials say they have searched the files for an amateur license, and are sure Randall doesn't hold one. In all, 21 HFers were ordered to show cause why their licenses should not be revoked. Several will be going to hearing before this issue gets to you, and at least one of them has been refused a ham ticket by the FCC. That case came in Alabama, when a former CBer (whose license had been revoked for numerous violations) applied for an amateur license but failed to appear for a hearing called to air the FCC's objections to giving him one. As one FCC staffer put it, "Every now and then we get lucky, but for every one we catch there seem to be a hundred more."

The fourth notice on WARC has been released by now, although its significance to amateurs is limited. Number five is the big one, and we expect to have details in our next issue. FCC spokesmen say it will be released around the first of June, and it will be a critical point for amateurs, since it could be the last allocations chart produced by the FCC prior to the 1979 WARC conference. Notice number four relates largely to technical matters, such as how to designate a given emission and so on. The two inch thick fifth notice was due before the Commission just as this issue was going to press.

The antenna/zoning case of Hank Greenberg W2LTP (May *73*) has become snarled in the kind of local politics New Jersey is famous for. Greenberg attorney Elson Kendal W2INL has moved for dismissal of the case, charging Cranford area officials with destroying records and intimidating witnesses subpoenaed by the defense. Kendal says the tension surrounding the case proved too much for Greenberg, who was hospitalized in late April with a heart condition. His release (and a final session of the Union County Court hearing Greenberg's appeal) was expected at deadline . . . but Kendal fully expects a further appeal, possibly in the form of a jury trial. Greenberg, in the midst of the zoning dispute over erection of four telephone pole antenna supports, attracted national publicity for his role in the rescue of a ship sinking in the Caribbean with nine persons aboard. As for the fund drive organized in Hank's behalf, several hundred dollars have been collected thus far. Sid Lieberman WA2FXB, the organizer of the drive, says the fund is currently $4500 in the hole, with New Jersey amateurs the major factor missing! Lieberman told *73* that had surprised him, since he felt hams closest to the case would be the most willing to help out. As for the ARRL, Lieberman says the League has flatly refused to cooperate in the Greenberg case, other than to offer minimal advice. The address for contributions is The Amateur Radio Legal Defense Fund for the Benefit of Hank Greenberg W2LTP (ARLDF/W2LTP), Midlantic National Bank/Raritan Valley, PO Box 996, Edison NJ 08817, Attention Mr. S.J. Lieberman WA2FXB.

Although a Federal court decision is preventing it from collecting license fees, the FCC continues to spend money. There is no solution to the fee problem in sight, but the need for more funding hasn't faded. In 1977, the FCC budget came in at over $55 million, but FCC officials have now requested an additional $1.6 million. A Washington spokesman told *73* the prime problem is the CB crunch — not only in new license applications, but in the cost of field operations teams tracking down illegal CB operators. There is also the cost of lab work, which has increased dramatically with the 40 channel changeover and adaption of new performance specifications. Congressional sources, though, are not so anxious to accept the FCC's judgment on the budget. As one House Appropriations Committee source put it, "The bureaucracy has to stop someplace . . . and it is not only the FCC that has some trimming to do . . ." The 1978 FCC budget request totaled nearly $60 million, but that may not be enough — a supplemental request is already in the works according to committee sources.

WHAT'S A
kilobaud
see page 190

Much has been said and written about Texas, and the extraordinary lengths to which Texans will go to be "biggest." But the testimony of The American Radio Council, in support of Texas House Bill #1440, offers a view rarely seen of the RFI/TVI situation. Before the House Committee on Business and Industry, the ARC argued that all TV sets ought to be filtered to reject unwanted signals. (That's the thrust of bill #1440.)

"Consider, if you will, the

The Dayton flea market at its peak on Saturday . . . fleas as far as the eye can see.

The Sea-Q-DX Convention, set for July 29-31, is being held in Seattle. It is a combined affair, with the Northwest Division ARRL, QCWA National, Northwest Computer Club, and AF MARS Region 5 conferences all rolled into one event. 73 publisher Wayne Green will be featured speaker at the QCWA Luncheon.

following facts: (1) By FCC estimates, there are now 23,000,000 CB radios in use in the US. In 1958, there were basically none. (2) The State of Texas has over 1,500,000 CB radios in use today, using the FCC 'rule of thumb' of 2.5 CB radios per licensed CBer. (3) There are over 800,000 licensed CBers in the State of Texas, which leads the country in CB radio saturation. Texas has 50% more Citizens Band radio stations than the next largest state (California). Yet Texas has only 50% of the population of California. (4) Nationwide, the FCC received 40,000 RFI complaints from consumers in 1974. Of these 40,000 complaints, 36,000 of them would never have come to the FCC's attention if the manufacturers had corrected design deficiencies in their home entertainment products at the time of manufacture. They expect 200,000 such complaints this year!"

The ARC's testimony went on to say interference has reached crisis proportions in Texas. As for the alternatives to requiring built-in filters, a former FCC engineer-in-charge was quoted as saying, "To require a radio operator stay off the air under such circumstances is similar to requiring a motorist to stay off the highway because another motorist with no brakes is using it!"

The Amateur Radio Manufacturer's Association (ARMA) held a meeting at Dayton to discuss the new FCC radiation limits and pending dockets on linear amplifiers and type acceptance. But the thrust of the session was Docket 20777 and the effect of the new harmonic limits on the ham radio business.

ARMA's hope is to grandfather existing gear, and the gear already on the production line or waiting for sale on dealers' shelves. January 1, 1978, is the retail cutoff date requested by ARMA, with an April 15, 1977, cutoff for manufacturing purposes.

As portrayed at the ARMA meeting in Dayton, the 20777 specifications came as a result of two distinct but related pressures. The first is the ITU international radio regulations, the basis of the upcoming 1979 WARC frequency allocations conference. It was felt in Washington, said ARMA's Bob Levine, that we must enforce the ITU limits here at home in order to have any right to limit the importation of amps considered illegal by American regulations. That's the second pressure point . . . information from various government agencies that huge shipments of broadband amps manufactured in Mexico, Korea, and Taiwan were headed for US markets. The new harmonic and spurious limits, then, were aimed at blocking further importation of "black box" amplifiers. Until now, the ARMA members were told, most bogus "black box" amps were manufactured here in the US, and it was the threat of thousands more coming in from abroad that forced the FCC's hand. Where all this leaves the American manufacturer of legal amateur radio equipment remains to be seen.

At deadline, the FCC had not acted on ARMA's grandfather clause proposal. ARMA itself was suffering growing pains, taking on new members and forming committees to deal with both pending and yet to be announced FCC proposals. Type acceptance is the prime fear, with most manufacturers convinced it will only raise prices and end up hurting the consumer.

The feeling is that anything — even 20777 — is better than type acceptance. The question is whether ARMA, or anyone in the industry, can find a better answer to the FCC's dilemma with the out-of-band pseudohams, the so-called HFers. And time, at this writing, is running out.

19
jamboree-on-the-air
jamboree-sur-les-ondes
+ RADIO SCOUTING '76
BE PREPARED
COMMUNICATE
World Scout Bureau
Bureau Mondial du Scoutisme
Case postale 78 1211 Geneva 4 Switzerland

What can you do about supporting Senator Goldwater's RFI bill now before the Congress? Write your senator in support of the legislation which now has reached the Senate Commerce, Science and Transportation Committee. Of special interest are the members of the committee, whose home constituents carry some weight. The members include: Warren Magnuson (WA), the chairman, Howard Cannon (NV), Russell Long (LA), Ernest Hollings (SC), Daniel Inouye (HI), Adlai Stevenson (IL), Wendell Ford (KY), James Pearson (KS), Robert Griffin (MI), Ted Stevens (AK), John Durkin (NH), Edward Zorinsky (NE), Donald Riegle (MI), John Melcher (MT), Barry Goldwater (AZ), Bob Packwood (OR), Harrison Schmitt (NM), and John Danforth (MO). If you live in any of those states you are in a good position to urge an early hearing on the bill and have some positive effect on its progress through Congress. At deadline no hearing had yet been scheduled.

Twenty-five years ago in Norway, a man named Les Mitchell decided to add a dimension to scouting. Amateur radio was the natural choice due to its accessibility by scout troops around the world. An annual international event grew out of Mitchell's efforts, known as the Jamboree on the Air. And the 1976 version set new records for participation, with over 12,000 stations on the air representing nearly every country that embraces scouting. Here in the US, the BSA (Boy Scouts of America) fielded over a thousand stations, ranging from complex multi-operator setups at BSA headquarters in New Jersey, to deep woods portable operations in the Pacific Northwest. The idea is to demonstrate ham radio, while at the same time promoting scout friendship among the millions of scouts around the world. As one organizer put it after overseeing the operation of AC1NRG at Meriden, Connecticut, "The scouts traded information about their projects, made contacts to trade patches, but one thing seemed to always arise — they wanted to know who the other guy on the radio thought would win the World Series." Condensed from the *Report of the Nineteenth Jamboree On The Air*, World Scout Bureau, Geneva, Switzerland.

The debate over business use of repeaters continues . . . this latest word comes right from the FCC, via *The Hilltopper*, bulletin of the Tompkins County ARC, Lansing NY. (Anyone who disagrees with this should contact FCC Rules and Legal Branch chief John Johnson in Washington DC, since these are his interpretations.)

In considering the legality of a transmission, you first have to consider if there is a third party involved in any manner (i.e., someone besides the two amateur operators who are talking to each other). If no third party is involved, and providing an amateur is not regularly engaged in buying or selling radio equipment for a living, two amateur operators may consummate a sale of a piece of radio equipment without violation of regulations. However, Mr. Johnson "recommends" that actual prices not be discussed.

An amateur not regularly engaged in buying and selling radio equipment may also inform other amateurs during a net that he has a certain piece of equipment for sale or trade, but again, it is "recommended" that exact price not be discussed. Now, this is all changed if the two amateurs are handling this traffic to or for any person except themselves.

No third party traffic may be handled if either operator or any other person derives monetary gain from the transaction. One amateur asks another amateur to call or contact a hamburger stand ordering burgers, fries, etc. . . . Mr. Johnson replied that although the call seems innocent enough, a third party (the hamburger stand) has a monetary consideration and the call is interpreted as not permitted. Calls to commercial establishments are permitted providing that the purpose of the call involves, at least in part, the welfare of a person or persons. A nonroutine call to a commercial establishment such as to a motel while traveling in another city to find a room is permitted.

In other words, if you are sort of desperate, such as needing a part for a stalled car out on the highway, or a wrecker to tow you into town, it is all right to pass such a call by amateur radio. However, if you made a call just to find a particular color of seat covers, the call would not be permitted. The crucial key as to whether a third party call or message is permitted depends on how desperate the situation is concerning the welfare of one or more persons. Apparently, the discussion of price of the article or service should be avoided. The writer realizes that this is most difficult to decide, what is welfare and what is not (reminds one of the definition of "sin"), but these are the only guidelines we have been able to get from the FCC. Thanks to W5EKP.

The folks who really got CB going — the truck drivers — may well get a new phase of the personal communications boom going. That's the illegal use of amateur VHF gear to escape the QRM on 27 MHz. A number of clubs have reported that truckers are buying 2m rigs and gathering on 146.58 MHz, CB handles and all! WB0ECX, via *Grid Leak*, reports he's on the lookout for bogus calls in the Denver area, after a check by area amateurs came up with 75 suspected phony calls in less than a day of casual monitoring. Thanks to *Grid Leak*, bulletin of the Pueblo Ham Club, Pueblo CO.

From club bulletins comes the news that 10m intruders are a growing problem. Several clubs report discussions on the topic, but most stopped short of any concrete action, choosing instead to "express our concerns to the ARRL." FCC officials are anxious for reports on the intruder problem both on HF and VHF, with your district engineer topping the list of where to send the information.

Illinois is the latest state to add anti-scanner laws. But amateurs are exempt in the final version of the legislation, largely through the work of statewide amateur clubs and organizations. The law bans the use of VHF and UHF monitors and transmitters in cars, unless the operator holds an FCC license (amateur or commercial). Most states with scanner laws on the books do exempt amateurs, but the best advice is to carry a photocopy of both the law and your license, to prove your point to law enforcement authorities. The Illinois law was expected to take effect October 1st, but will have to be added to the scores of other laws needing revision should the CB band be moved into the VHF/UHF region.

Tests are supposed to begin next fall on the new early warning over-the-horizon radar under construction in Maine by GE. The 39 million dollar system features 100 mile spacing between transmitter and receiver, a "footprint" of 1 million square miles in area, a transmitting antenna measuring 2,276 feet wide and 135 feet high, and 21 transmitters, rated at 100 kW each. Seven of them are to be used at a time over frequencies ranging from 5 to 30 MHz. *Electronics* magazine also reports that the beam can be scanned in azimuth and range simply by shifting frequency. The receive end has a 5,816 foot antenna, and will relay 96 three stage superheterodyne receivers to processors, and then into the Air Force radar system. Big Noise, anyone?

Another 10m beacon has been established here in the US. It's N4RD at Englewood FL on 28.075 MHz, full time. Power is 45 Watts output to a ground plane antenna. Owner/operator Robert Davis K4BRD says he's received over 100 QSLs since putting the beacon on the air at noon April 3rd. "This project was first conceived about a year ago," Davis told *73*. "I was listening on the 10m band and it was completely dead. I tuned down to the CB band, and it was very active. I realize that there is a difference in propagation between 11m and 10m, but it did not seem possible that there was that much difference. I came to the conclusion that no one was transmitting on ten. But how many were listening? What would be the result if there were a beacon on 10m? If the beacon was heard by someone, perhaps if they called CQ they could make a contact." Davis then found out that the IARU supervises beacons internationally, and he was assigned his frequency after contacting the coordinator in London, England. N4RD is home brew, with a Morse identifier. Other US 10m beacons include WA1IOB in Massachusetts on 29.150 MHz. For other beacon stations see May *73*, page 13.

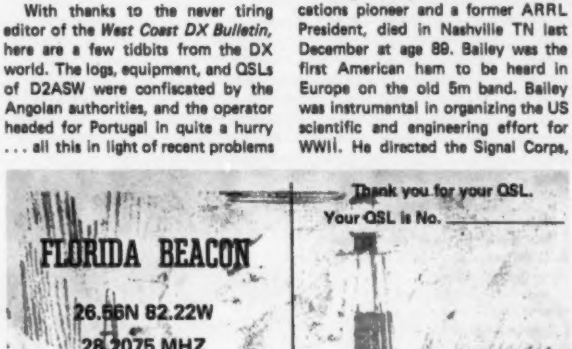
New Hampshire and Massachusetts are not exactly the best of neighbors. NH Governor Meldrim Thomson regularly criticizes the "mess" south of his state's border, while Massachusetts officials are quick to point out the lack of services available to New Hampshire residents compared to those offered in their state. A real war is underway between the two states over lotteries, liquor stores, horse and dog racing, and a half dozen other perennial issues, all debated over the Boston TV stations both states share. New Hampshire, says Governor Thomson, will not take a back seat to anyone . . . and he especially means Massachusetts. With that background in mind, it won't be hard to understand the logic of a bill introduced in the current session of the New Hampshire legislature, to specifically allow the use of microphones while mobile. Massachusetts ("Briefs," April *73*) has a little known law banning operation of motor vehicles without both hands on the wheel. At deadline the NH bill was before the house transportation committee. Anyone for a radiotelegraph endorsement? Thanks to WA1YEG.

With thanks to the never tiring editor of the *West Coast DX Bulletin*, here are a few tidbits from the DX world. The logs, equipment, and QSLs of D2ASW were confiscated by the Angolan authorities, and the operator headed for Portugal in quite a hurry . . . all this in light of recent problems in Angola. In Dahomey, 9G1JN ran into problems trying to get a TY license . . . seems a coup attempt may be responsible. W6YO appeared for 24 hours from Pitcairn on a CW only visit. Many CW DX types reportedly were grumbling about too much rag chewing and not enough QSOing. CE0AE, faced with rig problems, got a new Atlas onto Easter Island via W6YO, who's returning the original for factory repair. It seems Atlas played a big role in forwarding the replacement pending arrival of the ailing unit. A late March fire destroyed the Central Bureau of VERON at Arnhem in the Netherlands. Some records and subscription lists were lost, so those receiving *DX-Press* or awaiting correspondence are asked to write VERON, Box 1166, Arnhem, The Netherlands.

At deadline: The FCC approved a 30 day extension for comments on dockets 21116 (the proposed ban on linears capable of 24-32 MHz) and 21117 (type acceptance of ham gear). It was also reported that the manufacturer's association bid to enact a grandfather clause covering docket 20777 (bandwidth) was near approval.

Little reaction has been forthcoming on the disturbing suggestion in the book *The Real Spy World* by Miles Copeland, a former CIA organizer, that amateur transmissions are sometimes used for clandestine intelligence operations. He suggests that high speed "squirt" or "screech" signals are sometimes played in the background of ordinary ham radio messages. Copeland claims that squirt recordings "are still used to good effect on ham radio transmissions." It is hoped that if the CIA or any other organizations have ever used amateur radio in this way, the practice has long ceased. Reprinted from *The Indian Radio Amateur*, New Delhi.

George Bailey W2KH, a communications pioneer and a former ARRL President, died in Nashville TN last December at age 89. Bailey was the first American ham to be heard in Europe on the old 5m band. Bailey was instrumental in organizing the US scientific and engineering effort for WWII. He directed the Signal Corps, and was a founding father of the IEEE. As an amateur, Bailey was first to hear news of a sinking steamship, the *Viking*, which blew off course off Newfoundland in March, 1931. He also received first news of the Long Beach CA earthquake in March of 1933. Reprinted from the *IEEE Journal*.



FLORIDA BEACON

26.56N 82.22W

28.2075 MHZ

45 WATTS OUT

N4RD

ENGLEWOOD, FL

Thank you for your QSL.

Your QSL is No. ____________

N4RD's QSL – another beacon to help predict 10m openings.

see page 206

How to Make Better QSLs

HOW TO MAKE BETTER QSLs

One of the men who pioneered in the field of transducer design, Richard J. Billette, has died after more than twenty years of work in solid state engineering. He was 45.

Before helping to found National Semiconductor Corporation's transducer group in 1972, Mr. Billette spent one year in India establishing a technical school under the auspices of Dunwoodie Institute, Minneapolis, where he taught engineering. Prior to that, he held an influential position in the transducer activities of Honeywell's solid state electronics center in Minneapolis.

Mr. Billette held a key transducer circuit patent, and an important transducer application patent (flow meter) stemming from his work at National, in addition to a number of previous patents from Honeywell. A tireless and prolific worker, Mr. Billette was responsible for conceiving and implementing many new transducer concepts, features and applications. (Transducer devices are fairly recent electronic advances, which act as sensors to provide pressure readings and other important sense inputs for computer based systems. They have uses in many automotive, avionic and process control applications. They are said to "transform a computer into a robot," because they provide necessary external information for artificial intelligence, functioning as the "eyes," "ears," and "fingertips" of the computer.) Thanks to National Semiconductor Corporation.

Electrical storms, next to Murphy, are one of the amateur's worst enemies. Take the case of a Long Beach CA ham, as reported in the Long Beach *Independent*. "A lightning bolt struck the roof antenna of a ham radio set at the Long Beach home of Frederick Fowler. The roof and attic burst into flames. Fire Capt. Ralph Wallace said two engine companies and a ladder truck went to the Fowler home and extinguished the blaze in 15 minutes. He said Fowler and his wife were not operating any electrical equipment and consequently were not injured, but the house 'looked like a machine gun had ripped through it.' Electrical sockets, light fixtures and a doorbell button were blown apart, Wallace said. Metal corners used to hold the plaster during construction were electrified and bent, knocking plaster all over, he added, and the concussion moved a couch several feet. Part of the cedar shingle roof and part of the attic were destroyed, with damage estimated at $6,000. Fowler's radio set, however, was unplugged and was not damaged." How many of us would be able to say the same thing if an intense electrical storm hit our home QTH? Thanks to James Ross, Long Beach CA.

There are antennas, and then there are antennas, but we'd be hard pressed to do LU7MAL one better! Mel's Mendoza diggings include the six element 20m beam pictured here, on a 65 foot boom. According to Al OA4XX, who sent along the pictures, Mel started out with separate five and seven element arrays for comparison purposes, and discovered that although he didn't gain much on the transmit side between the two antennas, the big gain was on the receive end. Ultimately a six element antenna was decided on and constructed. One of the best points about the array is the way it folds over for adjustment and tuning. What's more, the antenna can be locked up in any direction to counter high winds, a major concern in maintaining large arrays anywhere, but especially near the Andes Mountains where Mel lives. Judging by the photos, the USA does not have the only claim to the "big gun" factor in the Americas. The rig at LU7MAL is as ultimate as the antenna farm, with full legal power and a well-known signal at contest time. Thanks to OA4XX.

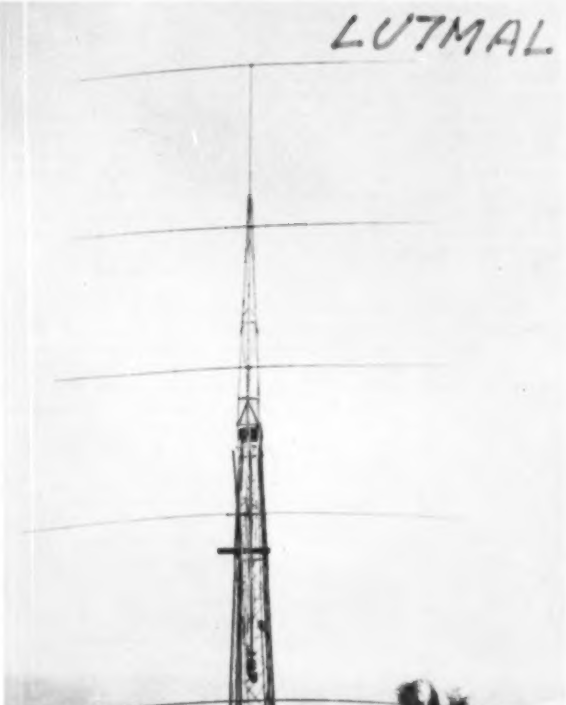
Local ham radio operators and the Coast Guard teamed up to rescue the 37-foot sailing sloop *Porsoius* when it lost steerage 25 miles off Ocean Park in the Pacific Ocean.

Lyle Clark W7RDR, Chuck Laird W7BCJ, and Jay Shepherd W7FBM combined their skills and equipment to locate the boat when it was discovered that the exact location was in doubt.

The story started when Laird and other operators were talking, using the Astoria WA repeater after a routine emergency drill on the radios.

The talk was interrupted when Bill Blaker WA6MUY, aboard the stricken vessel, called for Coast Guard assistance.

Laird set up a direct communications link with Air Astoria. The hams determined the boat's location and a helicopter was dispatched to find it.



The huge beam's best feature is probably the way it folds over for maintenance.

It was located at 12:02 am within four miles of the position determined by radio triangulation. A Coast Guard spokesman said drift could easily account for that.

Three hours later the motor lifeboat 44304 skippered by BM-2 Simonsen arrived on scene and took the vessel under tow. The 52-foot *Triumph* was dispatched, took over the tow, and just after noon Tuesday the *Porsoius* was safely moored in Ilwaco harbor.

The *Porsoius*, with three persons aboard, had a line foul the rudder, causing it to fall into the prop. The boat was dead in the water. Thanks to W7UFL (reprinted from the *Chinook Observer*, Long Beach WA).

Units of the Dallas TX County RACES played a key role in handling last February's railroad tank car explosion and fire. Within 15 minutes of the first explosion, the local net was activated and 56 units were available for crowd control, traffic duty, and communications. A command post was set up beside Dallas police headquarters, with information relayed to a half dozen police departments, fire departments and other emergency agencies. When officials thought a third rail car loaded with polyvinyl chloride might explode and spread toxic fumes, they needed to know the wind speed and direction and were surprised to find a meteorologist in the National Weather Service Office at Fort Worth monitoring the RACES net and ready with the answer. RACES personnel also manned barricades and set out flares, thus freeing many officers to return to their patrol duties. CB REACT teams also worked with the disaster team, manning barricades on the outer perimeter and urging the public to keep away via channels 9 and 19. Interestingly enough, the same Dallas County RACES group first spotted and tracked a major tornado that hit Dallas last May. Reprinted from *In the DARC*, a monthly publication of the Dallas Amateur Radio Club, Dallas TX.

The Pueblo (CO) Ham Club won some great PR with the news it would help the National Weather Service track tornadoes and other weather emergencies. An article in the *Pueblo Star Journal* reported a demonstration by the club, organized to show NWS officials 2m coverage on a volunteer basis. Fifty stations checked in, from as far away as Denver (110 miles), and the reaction was enthusiastic — the chief weather officer said he was amazed at how readily the amateurs responded to the practice alert. He went on to ask for the Pueblo club's help on a permanent basis. The club will maintain the weather watch 24 hours per day, seven days a week. Thanks to the PHC PR staff.

There's more feedback on amateur emergency efforts during this past winter's worst — W0SIN reports that the "Springs Repeater" near Colorado Springs was in action around the clock during the blizzard of late March under the direction of W0PT. A 75 meter link was maintained by K0CNV. Thanks to W0SIN.

There are two sides to every story, and the CB story is no different. The following appeared in the North Manchester IN News-Journal, *for Monday, March 18th. — Ed.*

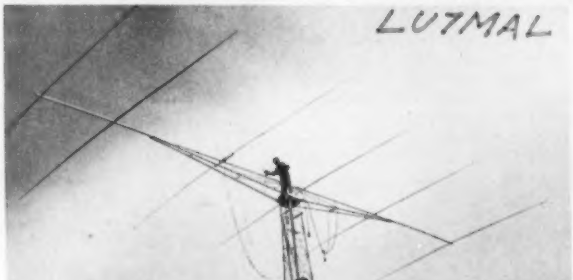
Pleasant Township Fire Department has answered its last anonymous CB fire alarm, according to Capt. Jesse Trickle of the Pleasant force.

Pleasant volunteers decided to crack down on false alarms received by CB radio after taking two false calls Friday from CBers. Trickle said the department would no longer respond to fire alarms reported over CB radio unless the caller gives his name, address, and call letters.

Friday's runs brought to seven the number of false calls received over the CB airways by Pleasant Township this year and has resulted in the wasting of over 100 gallons of gasoline as well as the time of the volunteers.

Trickle reported that Friday's calls were reporting fires on SR 15 and at the Laketon Refinery. Firemen were told that an 18 wheeler was on fire on SR 15 but nothing was found.

When firemen returned, they received another call that said the



Six elements on a 65 foot boom for 20m — that's the reason for such an outstanding signal from LU7MAL.

previous report was a mistake and there was a fire at the Laketon Refinery. Firemen went to the Refinery only to find the same thing as they had on SR 15. Thanks to WB9VKI.

A new blockbusting phenomenon is reported in certain Texas towns, where "FOR SALE" signs proliferate wherever the hated 11 meter ground plane dominates a local rooftop. Vigilante counter measures reportedly used by an aroused citizenry range from tape recording the offending transmission and giving it back to the CB neighbor via 150 Watts of stereo audio through an open 3 am window, to putting a straight pin through the offender's coax, and waiting for him to turn on his linear. Thanks WA6NCX, W6NIR, and *PAARA Graphs*, bulletin of the Palo Alta CA ARA.

The Environmental Protection Agency in Washington DC is considering a regulation to limit the height of all self-supporting towers less than 2.5 square feet (base cross section) to 34 feet.

It seems that free-standing towers experience wind shear effects which shake the towers. It also seems that, especially in the late spring and summer, this shaking is transmitted to the surrounding earth. The vibrations disturb earthworms, causing them to come to the surface (often during the hottest part of the day). Exposure of the earthworm to the sun's direct rays causes them to die from sunstroke. Earthworms are very important facets of the ecology — hence the EPA's concern. Thanks to the Cascades Amateur Radio Society *Action Mini-Mag*, Jackson MI.

Many of us dream of the ultimate station, but few of us ever seem to get that far. One who has is Ted Gamlin K1VBL of Chester NH. The photos show only a portion of Ted's multi-op setup, from the antenna farm viewpoint. Since Ted took these pictures, the winter of '77 has done its dirty work, and the big 165-foot tower (which supported a six element 20m beam and the stationmaster for Ted's 220 MHz DXalert repeater) came down. Also lost on at least two occasions was the 4 element 40m yagi, but not before the station, signing W1RR, put in a strong showing in the ARRL DX contest. Now that the warmer weather has arrived, Ted is busily rebuilding, spreading out the towers and in general beefing up the system for next winter . . . and the next contest season.

This is, of course, the Silver Jubilee of the reign of Queen Elizabeth II. And, not unlike the American Bicentennial which preceded it, the Jubilee means special calls for amateurs. A "GE" prefix is substituted for the normal one, at the individual amateur's option. The event lasts from 0001 GMT June 4th through 2359 GMT on June 12th, but it isn't being received with exactly open arms among English hams. A report in *Mobile News*, the Journal of the Amateur Radio Mobile Society, put it this way — "Obviously, if this nonsense is adopted, nobody will have a clue what country they are working. When poor Arthur Milne G2MI read this out on the 80m bulletin, he couldn't help muttering about the confusion it would cause to the QSL bureau. We can only hope that this one will go off like the proverbial damp squib, as did the American Bicentennial calls which were utterly confusing."

An FCC news release says alien hams gaining American citizenship must take the American amateur exams to continue operating. That applies even when the old license is still in effect. However, aliens will be able to keep their US calls granted initially under reciprocal agreement.

Canadians planning to operate in the US must first obtain form 410 from the FCC. Reports that current reciprocal agreements between the two countries allow "instant" operation on either side of the border are simply untrue. Operation without authorization may be in the cards in the future, however, since both the FCC and the Canadian DOC have reportedly agreed on it, but a treaty has not yet been signed. Thanks to *Transborder*, bulletin of the International Repeater Group, Fredericton NB.

A Wayne King special feature in the Sunday *New York Times* gives us some insights into a few of the 100,000 complaints from the public received by the FCC in 1976. They represent some of the more fascinating items of RFI.

The strident tones of "jelly belly" startling a poor housewife as she opened her electronic oven . . . A character called "rubber ducky" shouting, "I'm comin' home, warm up the bean pot, honey" just as the minister was closing the coffin during funeral services . . . As another pastor said, "forgive us our trespasses," one "dragon lady" in less than dulcet tones came bleeding through the PA speakers with "That's a big 10-4, good buddy," — such ain't the way to perorate the Lord's prayer.

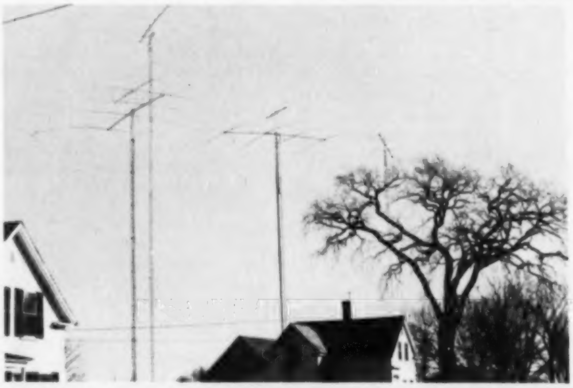
A raucous "hey, what say, good buddy" ruined the romantic moment for a Houston couple who were theretofore using to best advantage the soft music on their stereo. A Dallas police chief was equally upset when his electric organ started talking with a trucker's twang, even though the switch was off, and a southern chanteuse named Cheryl Russell found herself suddenly off-key and mentally anguished when her night club mike talked back to her. The New Mexico Cooperative Interference Committee investigated 11 meter signals which drove a local citizen to a psychiatrist — the fillings in his teeth were picking up more than one good buddy. CBers trying to get 9 pounds out of a 5 pound Tiger 23 have caused widespread havoc with electronic controls on fuel injection systems ranging from spitting VWs to sputtering Mercedes.

73

...tell us you love us

see page 199

The FCC announces publication of a new 35 page booklet, "How To Resolve Radio-TV Interference Problems." It will be available from the GPO beginning in late June, for $1.50.



The K1VBL antenna farm last fall. Since the picture was taken, winter has done its dirty work, taking out the largest tower and forcing a rebuilding program this spring.

As is obvious from this shot, K1VBL let Ma Bell do his site research work for him. Most contestors are by now aware that it's paying off.

booklet includes interference information on TVs, BC radios, telephones, stereo systems, and other electronic devices.

Amateurs everywhere owe Fred Maia W5UTT a vote of thanks. Maia was a major contributor to the successful introduction of an RFI bill in this year's session of the Texas legislature. The RFI bill's introduction followed withdrawal of a measure that would have set criminal penalties on interference cases, strictly from the ham's or CBer's point of view. The new bill would force the installation of interference filters on TV sets at the dealer level, and place either a $100 fine or actual damages (whichever is greater) for interference caused by the lack of a filter. But the Texas amateurs and their supporters did not stop there. A section was added to the bill suspending normal legislative procedures to allow for early action and an immediate effective date for the new law upon passage!

The CB problem in Australia has become so bad that the state police can stop and search any vehicle suspected of carrying illegal 27 MHz equipment. All amateurs in Australia are advised by *Amateur Radio* magazine to carry their license or a photocopy of it with them. It is also required that they carry their license renewal certificate and a log book. Amateurs are further instructed to remove their mobile gear if they lend their car to spouses or friends, so the driver does not get booked for illegal possession of radio transmitting gear.

In "Briefs" in the May issue (page 40), an item appears which gives a false impression of the facts. It says, "A licensed amateur . . . was fined $100 . . . for inadvertent jamming of radio and TV shows . . . for which he could have been fined a maximum of $1600."

The facts are that damages of $25 each were awarded to four neighbors who had sued the user of a CB station for $400 damages each because, for about a year, despite repeated complaint, their radio and TV reception had been marred by a "strange voice" which intruded "at all hours of the day and evening."

In Canada, the Radio Regulations still forbid the use of CB for "transmissions of a frivolous nature" and "a communication used in itself as a diversionary or recreational activity," but in fact these prohibitions are not enforced. But another provision says, "no station . . . shall be operated so as to cause interference to any licensed radio station or a private receiving station." The sensible ham or CBer operates his gear with discretion, knowing that there is a fine and debatable line between his right to operate and the right of his neighbors to enjoy their listening and viewing.

The court case which ended in the judgment against the CBer was argued around the principle that the exercise of an act of ownership is subject to the exercise of the same right for neighboring owners. It was found that "the owner of such a device is responsible for its injudicious use if such use causes inconvenience to others. The theory of misuse of right must be applied here. The fact that one exercises a right does not mean that one may thoughtlessly, albeit without malice, interfere with others in the exercise of their rights."

Another interesting reference is to the possiblity of high pass filter protection on the TV sets. "It is false to claim that the owners of television sets should provide their sets with special filters, since the use of a television set is not regulated to the same extent as that of a CB device. Thus, the intangible damages incurred by the applicant must not be given any less weight because he did not provide his own television set with special filters." Thanks to VE7BS.

We've heard about the ATV madness sweeping the country, but things are clearly getting out of hand! Consider the proposal of some Baltimore (MD) ATVers, as published tongue-in-cheek in *The Milliwatt,* bulletin of the Baltimore Radio Amateur Television Society (BRATS). "Have you noticed that most commercial TV stations stop transmitting at night? Apparently they are not interested in using their spectrum 24 hours a day. Tell you what. When they go off, allow the hams to transmit ATV on those unused channels. Betcha dollars to donuts ATV would fill up those unused channels fast and attract more viewers than those moldy all-night movies. BRATS hereby announces its preliminary plan for channel 11 input, channel 2 output, ATV repeater for Baltimore." Thanks to K3SVC.

AR NS

Amateur Radio News Service

The Amateur Radio News Service was founded many years ago as a result of a need for the exchange of ideas among and between those radio amateurs concerned with club newsletters and public relations. In the newsletter field, ARNS attempts to cover all aspects of producing and mailing a club paper. To one entering the field it soon becomes evident that producing a club paper is somewhat of a unique process, primarily because standard practices of printing will not necessarily apply. The publisher seldom has equipment available and in many cases must operate without any equipment at all! Few club paper editors have had any experience in the field. It has been demonstrated that, through information available through the Amateur Radio News Service, a new paper editor can easily surmount many of the problems involved in producing a club paper.

The monthly publication, *The ARNS Bulletin*, contains in each issue helpful hints for producing the paper. Currently each issue contains an installment of the booklet "The Club Paper," bringing the publication up to date. These installments cover all aspects of producing a club paper, from the origin of the text to finally placing the papers in the mail. When completed, each member will receive a copy.

ARNS numbers among its members many professionals possessing expertise in almost any subject of producing a paper. Thus the newcomer has access to a recognized expert who can answer almost any question relative to producing a club paper. Because of the improvement in the club paper and since the editor has access to continuing information, most clubs pay the nominal cost of the editor's membership in the Amateur Radio News Service.

In the Public Relations field the Amateur Radio News Service endeavors to cover suggestions for operating in the public relations field, including types of items to be submitted to the media. Again, ARNS has among its members many who are professional public relations individuals, and each member has access to information available from them.

The Amateur Radio News Service has members in many foreign countries. It is a service for amateur radio editors and does not issue "news" items as such. However, each issue of *The ARNS Bulletin* contains quotes from other club papers which can be copied for use in any club paper. Thanks to W9MOL and WA3HEN.

For those interested in building the TV game circuit presented in the Oct., 1976, issue of *73* ("Hey, Look What My Daddy Built!"), and have either had trouble finding the AY-3-8500-1 chip or did not want to spring for the $35, we have good news! Poly Paks now has the chip listed on the front page of its newest (221) catalog, for $14.95. We thought this might make some of you happy. — WB1ASL.

Hams have come up with some ingenious uses for beeps. LIMARC, the Long Island Mobile Amateur Radio Club, uses a beep to tell you when you have paused long enough between transmissions for the machine to recycle. When you hear the beep, start talking.

Vancouver's VE7RPT machine beeps users when their regular power has ceased and emergency battery power is being used. Dave Williams VE7MQ says that the battery supply gives full emergency capabilities, but only for a finite duration. "If the beep tone is on," he writes in the *British Columbia FM Communication Association Bulletin,* "please be exceedingly brief, or better yet, limit your use to emergency traffic."

The Miami Valley FM Association *FM Scanner* reports that their 04/64 machine emits a double beep if an emergency is in progress. Monitoring stations are instructed to stand by and listen when the double beep is heard. Net control will then ask for check-ins if needed.

A wide area communications system, which has received FCC authorization, will consist of 6 or 7 strategically located repeater stations capable of retransmitting signals from weak stations, such as HTs, throughout the 30,000 square mile area around Kansas City. Each of the linked repeaters can be tone or carrier accessed as desired by the control operator. The repeaters may also be operated independently without interference between terminals. A complex set of commands will be given by the headquarters communications center (W0SHQ), which can monitor traffic on each repeater. A minicomputer, located at headquarters, controls the entire system.

The Association of Saint's Church Radio Amateurs, headquartered in Independence MO, says that the system is the only one outside of the western US to have such a large coverage area. Mountain-based repeaters in the west easily provide 200 mile coverage, while plains states have no such height advantage.

Congratulations are in order to the Cuyahoga ARS of Cleveland OH, after providing assistance to the local American Cancer Society during its annual fund drive. Mobile stations were provided by the local club, whose members delivered 365 cubic feet of literature and informational packets to zone captains for distribution throughout Cuyahoga County. Thirteen locals participated, along with a prospective amateur (a security guard at the Cancer Society headquarters building) who gave up a day off to join the hams! Thanks to WA8GEO.

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CONTESTS

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

Official logs, check sheets, and summary sheets for the CAN-AM Championship Contest may be obtained from CANADX, Box 717, Station Q, Toronto, Ontario M4T 2N7, Canada. Include a large SASE for samples. Full rules for this contest will appear in the next issue!

QRP SUMMER CONTEST

Starts: 1500 GMT
Saturday, July 2
Ends: 1500 GMT
Sunday, July 3

The contest is organized by the DL Activity Group-CW. Work 15 hours maximum during the 24 hour contest period, with no more than two pause periods. Select up to 5 bands from 160 to 10 meters. General call is "CQ QRP TEST." A station is not handicapped if CO/VXO control *and* VFO control are used on the same band or the input power of a commercial rig is reduced to below 2.5 Watts. QRO stations — same rules, but work only QRP stations and sign ". . ./QRO"; scoring is the same.

EXCHANGE:

RST, QSO number, and input (1 to 9). Add "x" if transmitter is CO or VXO controlled. Example — 579 000/8x.

SCORING:

QSOs with all stations are valid unless running QRO; then only QSOs with QRP stations count. Contacts with your own country count 1 point, own continent = 2 points, DX = 3 points, and score 3 additional points for a QSO with another QRP station. Score additional handicaps as follows: 1 handicap point for each station using below 3.5 Watts input or crystal controlled transmitter. Maximum handicap is 4 for any QSO. Both stations multiply QSO points times the handicap points plus one (QSO pts x 5 max) to find total QSO points for that contact. Multipliers are as follows: own continent = 1, DX = 2 points per band and country according to latest DXCC list, but call areas in JA, PY, VE, VK, W, and ZS count extra. Final score is total QSO points (including handicap pts) times the total multiplier.

ENTRIES:

Send entry including a "mini-log" to Hartmut Weber DJ7ST, D-3201 Holle, Kleine Ohe 5, Fed. Rep. of Germany. Logs should be postmarked no later than Feb. 15.

ARRL STRAIGHT KEY NIGHT

Complete rules in June issue of *QST!*

If similar to last year, starts 0100 GMT July 3rd and ends 0700 GMT July 4th. Send "SKN" instead of "RST" during QSOs to identify contest stations. Try 60 to 80 kHz up from bottom edge of the band. After contest period, send a list of calls of the stations contacted during the contest period plus your vote for the best fist heard. All entries should be addressed to ARRL, 225 Main St., Newington CT 06111.

APOLLO II 8th ANNIVERSARY CONTEST

July 16 to 17
6 pm to 9 pm local time

Use all VHF/UHF bands, all modes — except repeaters!

CALENDAR

July 2-3	QRP – Summer – Contest
July 4	ARRL Straight Key Night
July 9-10	IARU Radiosport Championship
July 16-17	Apollo II 8th Anniversary Contest
July 16-17	10-10 Net Summer QSO Party
July 23-25	CW County Hunters Contest
Aug 20-21	New Jersey QSO Party
Aug 20-21	Worldwide SARTG RTTY Contest
Aug 20-22	CAN-AM Championship Contest
Aug 27-28	All Asian Phone Contest
Sept 10-11	Washington State QSO Party
Sept 10-11	ARRL VHF QSO Party
Sept 24-25	Delta QSO Party
Oct 1	Open CD Party – CW
Oct 15-16	Open CD Party – Phone
Oct 15-17	Manitoba QSO Party
Nov 5-6	ARRL Sweepstakes – CW
Nov 12-13	IPA Contest
Nov 13	OK DX Contest
Nov 19-20	ARRL Sweepstakes – Phone
Nov 19-20	WWDXA International CW Contest
Nov 19-20	All Austria Contest
Dec 3-4	ARRL 160 Meter Contest
Dec 3-4	TOPS CW Contest
Dec 10-11	ARRL 10 Meter Contest

Power classes as follows: Class I — 100 to 300 Watts input; Class II — 25 to 100; Class III — 5 to 25; Class IV — 1 to 5. Special XYL class — any power permitted. Club class — aggregated scores.

SCORING:

Each completed contact counts 2 points. Same station may be reworked on different mode and/or band for additional 2 point scores. Each different zip code worked will count as 1 multiplier; like zip codes worked will not be counted as a multiplier.

AWARDS/ENTRIES:

Trophy plaque to highest score in each power class and XYL and Club classes. Space Net certificates to second and third places in all classes. All logs to be postmarked no later than Aug. 10, 1977, to: VHF Space Center, Box 15, Sumterville FL 33585.

TEN-TEN INTERNATIONAL NET SUMMER QSO PARTY

Starts: 0000 GMT July 16
Ends: 2400 GMT July 17

The contest is open to all amateurs, but only members are eligible for awards. All contacts must be made on 10 meters, but any mode may be used.

EXCHANGE:

Name, QTH, and 10-10 number.

SCORING:

Score 1 point per contact and add 1 point if with a 10-10 member (max. 2 pts per QSO). Give name of your chapter for chapter credit.

AWARDS:

1st and 2nd place certificates for each US Dist, KH6, KL7, VE districts, Central America and Caribbean, South America, Europe, Africa and South Atlantic, Asia and North Pacific, Australia-New Zealand and South Pacific.

ENTRIES:

Members only send logs to Grace Dunlap K5MRU/0, Box 13, Rand CO 80473 no later than Aug. 31, 1977. Results will be published in the Fall Bulletin. Special certificates for all CW scores and if 10 or more logs are received from Novice members.

CW COUNTY HUNTERS CONTEST

Starts: 0000 GMT July 23
Ends: 0600 GMT July 25

The CW County Hunters Net invites all amateurs to participate in the 1977 CW Contest with all mobile and

RESULTS

RESULTS OF THE TEN-TEN INTERNATIONAL NET WINTER QSO PARTY

WA1UAD	323/610
WA1STR	304/566
K9EGA/2	398/729
WB2MAN	248/461
K3LYW	478/872
W3RJ	240/434
W4MNZ	491/942
WB4CHK	401/748
WA5JDU	560/1029
WB5EHF	456/860
WA6UZA	376/698
WA6NAU	289/520
K7PXI	345/650
WA7BPF	299/553
WB8FAG	456/835
W8DMY	294/552
**W9NIN	315/586
WA9IXF	205/393
W9BPU	208/392
WB0QHV	710/1308
WB0CEI	396/733
KH6IAA	435/796
KH6ILF	374/665

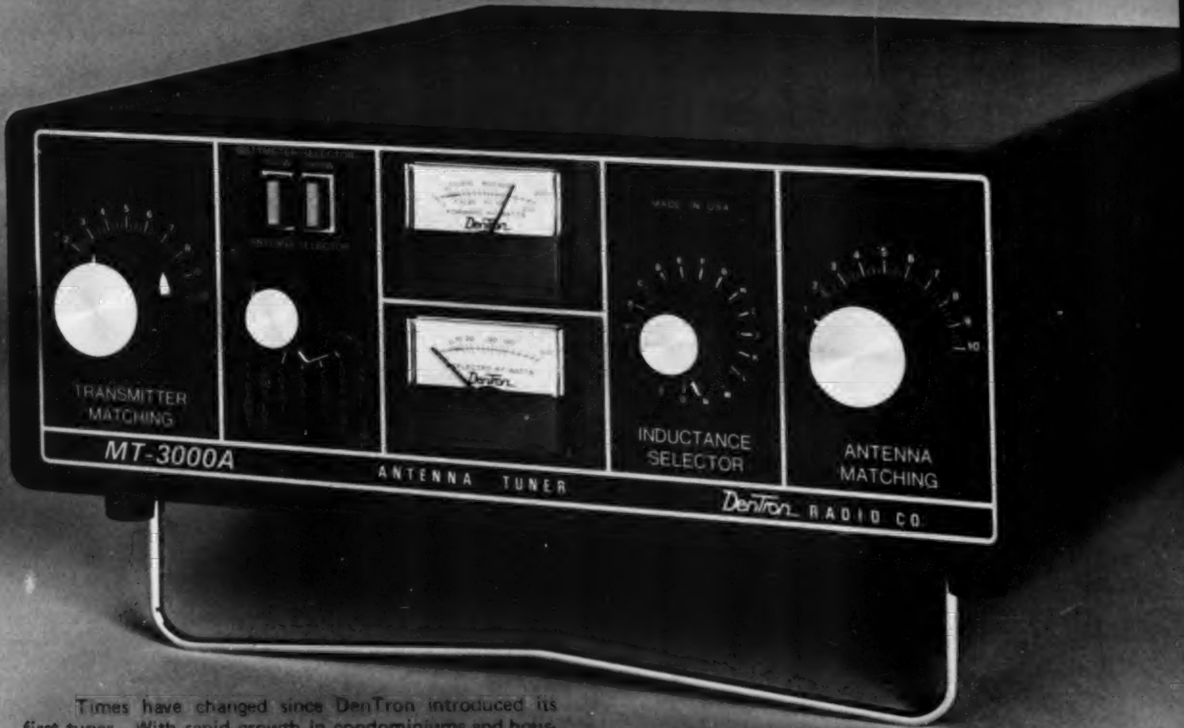
VE2DZO	78/109
VE2XL	30/53
**VE3AHN	152/223
VE4VV	71/136
VE4UO	7/12
VE6BCC	13/23
VE7CNY	181/326
VE7DHE	121/217
HP1GD	175/334
LU7FAG	287/531
CE3EZ	266/480
VK4JP	58/89
VK4AMO	54/79
JA3XOG	52/79
JA9NGS	47/73

**Multi-operator station.

Ten-Ten Net Chapters:

Southern New England	7614/14,426
Gateway (Missouri)	5683/11,010
Cincinnati Area Ten Tuners	4920/9,374
Colorado	3316/6,251
Bay Area (Cal.)	3242/6,137

Look closely at the new MT-3000A. You've never seen anything like it.



Times have changed since DenTron introduced its first tuner. With rapid growth in condominiums and housing developments, we have new problems that require new solutions.

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The compact size alone of the MT-3000A (5½" x 14" x 14") makes it revolutionary. Combine that with its four built-in accessories and we're sure you'll agree that the MT-3000A is one of the most innovative and exciting instruments offered for amateur use.

At **$349.50** the MT-3000A is not inexpensive. But it is less than you'd expect to pay for each of these accessories separately.

As unique as this tuner is, there are many things it shares with all DenTron products. It is built with the same meticulous attention to detail and American craftsmanship that is synonymous with DenTron.

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portable operation in less active counties welcomed and encouraged. General call "CQ CH." Stations may be worked once per band and again if the station has changed counties. Portable/mobile stations changing counties during the contest may repeat contacts for QSO points. Stations on county lines give and receive only one number per QSO but count each county for a multiplier.

EXCHANGE:

QSO number, category (P = portable, M = mobile), RST, state-province-country, and county (for US stations).

FREQUENCIES:

3575, 7055, 14070, 21070, 28070.

SCORING:

QSOs with fixed station count 1 point, portable/mobile stations = 3 pts; multiply QSO points times number of US counties worked. Mobiles/portables calculate their score on the basis of total contacts within a state.

AWARDS:

Certificates awarded in three categories: F — Highest fixed or fixed portable in each state, province, and country with 1,000 or more points; P — Highest station operating portable (not normal point of operation) with 1,000 or more points; M — Highest mobile in each state operating from 3 or more counties with a minimum of 10 QSOs per county.

Trophies to highest single operator station in categories P and M. Additional awards where deemed appropriate.

ENTRIES:

Logs must show category, date/time in GMT, station worked, exchanges, band, QSO pts, location, and claimed score. All entries with 100 or more QSOs *must include a check sheet* of counties worked or be disqualified from receiving awards. Enclose large SASE if results desired. Logs must be postmarked by Sept. 1 and sent to: CW County Hunters Net, c/o Jeffrey P. Bechner W9MSE, 673 Bruce St., Fond du Lac WI 54935.

TENTH ANNIVERSARY JERUSALEM AWARD

The Jerusalem Award Committee announces the creation of a new certificate to commemorate the tenth anniversary of the unification of Jerusalem. The certificate will be made available to both amateurs and SWLs. To qualify, contact 8 amateur stations in Israel, with at least 3 of them located in Jerusalem, the capital. All contacts must be made in the year 1977! Have log entries certified by another radio amateur and send log extracts along with 10 IRCs to: Jerusalem Award, PO Box 4079, Jerusalem 91 040, Israel.

Also of note: The requirements for the regular Jerusalem award have been changed to require contacts with 8 stations in Israel, with 3 in Jerusalem. The address is the same as shown above.

IARU RADIOSPORT CHAMPIONSHIP

Complete rules in the June '77 issue of *QST!*

Oscar Orbits

Oscar 6 Orbital Information

Orbit		Date (July)	Time (GMT)	Longitude of Eq. Crossing °W
NA	21530 BTN	1	0021:23	67.1
N	21543	2	0116:19	80.9
NA	21555 BTN	3	0016:15	65.9
N	21568	4	0111:11	79.6
NA	21580 BTN	5	0011:07	64.6
NA	21593 BTN	6	0106:02	78.4
N	21605	7	0005:58	63.4
NA	21618 BTN	8	0100:54	77.1
N	21630	9	0000:50	62.1
NA	21643 BTN	10	0055:46	75.9
N	21656	11	0150:41	89.6
NA	21668 BTN	12	0050:37	74.7
NA	21681 BTN	13	0145:33	88.4
N	21693	14	0045:29	73.4
NA	21706 BTN	15	0140:24	87.2
N	21718	16	0040:20	72.2
NA	21731 BTN	17	0135:16	85.9
N	21743	18	0035:12	70.9
NA	21756 BTN	19	0130:08	84.7
NA	21768 BTN	20	0030:04	69.7
N	21781	21	0124:59	83.4
NA	21793 BTN	22	0024:55	68.4
N	21806	23	0119:51	82.2
NA	21818 BTN	24	0019:47	67.2
N	21831	25	0114:42	80.9
NA	21843 BTN	26	0014:38	65.9
NA	21856 BTN	27	0109:34	79.7
N	21868	28	0009:30	64.7
NA	21881 BTN	29	0104:26	78.4
N	21893	30	0004:22	63.4
NA	21906 BTN	31	0059:17	77.2

Oscar 7 Orbital Information

Orbit	Date (July)	Time (GMT)	Longitude of Eq. Crossing °W
12006 B	1	0050:11	66.1
12019 A	2	0144:28	79.7
12031 B	3	0043:46	64.5
12044 A	4	0138:05	78.1
12056 B	5	0037:26	63.0
12069 AX	6	0131:43	76.6
12081 B	7	0031:04	61.4
12094 A	8	0125:21	75.0
12106 B	9	0024:41	59.8
12119 A	10	0118:59	73.4
12131 BQ	11	0018:19	58.3
12144 A	12	0112:36	71.8
12156 BX	13	0011:57	56.7
12169 A	14	0106:14	70.3
12181 B	15	0005:34	55.1
12194 A	16	0059:52	68.7
12207 B	17	0154:09	82.3
12219 A	18	0053:29	67.1
12232 B	19	0147:47	80.7
12244 AX	20	0047:07	65.5
12257 B	21	0141:24	79.1
12269 A	22	0040:45	64.0
12282 B	23	0135:02	77.6
12294 A	24	0034:22	62.4
12307 BQ	25	0128:40	76.0
12319 A	26	0028:00	60.8
12332 BX	27	0122:17	74.4
12344 A	28	0021:38	59.3
12357 B	29	0115:55	72.8
12369 A	30	0015:16	57.7
12382 B	31	0109:33	71.3

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the north pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes.

OSCAR 6: Input 145.90-146.00 MHz; Output 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz.

OSCAR 7 Mode A: Input 145.85-145.95 MHz; Output 29.40-29.50 MHz.

Mode B: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

Orbits designated "X" are closed to general use. "ED" are for educational use. "BTN" orbits contain news bulletins. "Q" orbits have a ten Watt erp limit. "L" indicates link orbit. "N" or "S" indicates that Oscar 6 is available *only* on northbound or southbound passes. Satellites are not available to users on "NA" days.

Corrections

Thank you very much for printing my crystal checker circuit on page 164 of the April, 1977, issue of your great magazine. There is only one small error in the schematic. Due to a misprint (I hope), the transistor part number reads 50011. It should be S0011. I think that whoever builds the circuit will understand the error.

John Mairs WD4CEA
Springfield VA

I have had considerable mail response on my article that was in the May, 1977, issue of *73*, "All-Electronic SELCAL." I have one thing to say: "These hams who are supposed to be dummies can really pick out the errors." It has been brought to my attention that all the 5 volt power leads to the 7473 flip-flops have been reversed. That would be IC1, 2, 3, 4 and 5. Also, Q1 and Q2 have been labeled incorrectly — they should be reversed. These are all my errors; I should have caught them but did not. You did make one error, and that is that resistor R3, which goes to the collector of the 2N706 and got its base driven from input 15, should also be connected to the vertical line that goes past it on the right-hand side (to the manual reset button).

A. Sperduti WB2MPZ
Hamburg NY

My apologies to those people who have had problems with the "NASA-type Beeper" in the January 1977 issue. The value of C5 which determines the tone of the beep should be .01 uF instead of the .001 called for. The .001 produces a beep of around 10 kHz — high enough that most people thought that the circuit was not working at all. With this change, a 1 kHz tone is produced.

Also, in Fig. 2, the ground pin of U1 is labeled GND but not connected to ground, which it, of course, should be. Fig. 1 is correct as shown.

Bob Shattuck WB3GCP
Gillett PA

This note is to advise you that there is an error in the text that accompanies the circuit I sent you for the Circuits^2 section of *73* which appeared in the April, 1977 issue, page 164. The schematic is correct as printed, but the fuse rating should be less than the current rating of the SCR. This is so that the fuse will blow before the rating of the SCR is exceeded. If the SCR's rating was exceeded, the SCR would be destroyed, of course.

I thought that you would like to be advised of this error. Thank you.

Paul Hurm WB8CLF
Seven Mile OH

I was very pleased to see my circuit published in the April issue of *73*. However, I must point out a mistake. The 470k resistor on the output of the op amp in series with the bipolar LED is incorrect. The value which I originally used was 470 Ohms.

Michael Black VE2BVW
Montreal, Quebec

Tracking the Hamburglar

RIPPED OFF: In Jersey City NJ, Regency HR-212 #24-01529 with 34-94, 52-52, 28-88, 73-73, 37-97, 31-91, 94-94, 58-58 and 55-55. Duplex transmit and receive. Jack Smith WB2CDL, 53 Orange Ave., Staten Island NY 10302.

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LETTERS

NOT SURE

Last year I saw an article in your magazine (I think it was your magazine, but I'm not sure) which interested me very much, but I have forgotten what it was. I wrote the name of the article in my notebook after I had read it, but I have lost the notebook.

I have also lost the magazine which the article was in. Will you please send me another copy of the magazine, if it was your magazine?

Wayne Schuler EP2US
Tehran Iran

P.S. Keep up the good work . . . whatever it is you do.

Try the Guide to Periodical Literature, *Wayne. Perhaps you'll find a reference to your missing article! — Ed.*

HARMONY

I harmonize with your February 1977 *73* editorial. But I cannot sing, so I yodel. I am heart hurt over the ARRL *QST* format, monstrosity advertisements, miniscule matter of direct interest to me (licensed since 1935 — W6MMZ and KL7DG only calls — past 12 years with FCC Monitoring, Anchorage). I am an ARRL member and once served as Alaska SCM. Recently I subscribed to *Sky and Telescope* in place of renewing *QST*.

Enclosed is a copy of my QRPp 27 meter band proposal which *Worldradio* carried for me but *QST* would not print. Can you give this idea some emphasis? FCC has not yet responded to my proposal of January 7, 1977, but I am braced for a long wait in this quarter.

John P. Trent KL7DG
Anchorage AK

I am proposing shared use of 11.300 to 11.325 MHz by very low power A-1 emission only for the Amateur Radio Service with the Aeronautical Mobile Service on a shared non-interference basis, worldwide.

Power limit for the Amateur Radio Service would be 5 Watts input. This would provide better than 15 dB protection in all areas of the world.

This proposal has been prepared in an original and 19 copies in response to Docket No. 20271 dated 6 December 1976 which treats WARC-79 allocations with the binding effect of treaty to signatory countries until the year 2000.

In this Docket No. 20271, the Amateur Service is marked for a reduction of its 15 meter allocation by 250 kHz shaved off the top of this band and reallocated to the Maritime Mobile Service. This is a significant loss of frequencies not entirely offset by proposing the addition of 50 kHz to the bottom of the 20 and 40 meter bands and the establishment of 160 to 190 kHz low frequency band for amateurs.

For more than a decade, the 11.300 to 11.325 MHz section has been observed by me. I have noted quite limited use of these frequencies by the Aeronautical Mobile (R) Service. On a nightly basis, unlicensed Chinese fishing boats with spurious A-1 emission use the 11.300 to 11.325 MHz frequencies for navigation and commercial fish catch information.

Insertion of a vaccine type active amateur on very low power will serve to develop thousands of intruder watchers to assure the band purity for primary use by Aeronautical Mobile Service.

John Trent KL7DG

HIGH STANDARDS

First of all, I would like to congratulate you for the fine efforts that you have put into amateur radio and also *73 Magazine*. I do not always agree with you, nor do I enjoy computer articles, but it is impossible to please all of us.

Being from Canada, perhaps it is wrong for me to criticize the FCC license standards, but I feel it is wrong to keep lowering the high standards of amateur radio to accommodate a small group of lazy individuals who cannot be bothered to put forth a reasonable amount of time and effort to become amateurs. I for one am not against a Novice class license, as it provides valuable on-the-air experience, but I do feel that the present code and theory tests are too relaxed (with the recent power increases). If the present trend continues, all we will get out of this is a glorified Citizens Band, which I am sure no serious amateur ever wants to see. The present rules which allow a person to go from Novice to Extra class in almost no time at all are wrong, as a lot of extra studying does not make up for time-tested experience.

The majority of amateurs are far too eager to get onto voice. Anyone can learn how to talk into a mike. It's done every day by common people, but it takes a good amateur to become proficient in CW. Tune across the CW portion and see how much really good CW you can find. Sure, there's a lot of speed, improper spacing or none at all, and Es and Rs sent like Fs. CW is nothing to be ashamed of — it was the beginning of amateur radio.

The benefit of properly conducted code and theory classes, along with good study material, cannot be overemphasized. The *73* code tapes and study guides are excellent, whether you are just starting out or are planning to upgrade your license.

I would like to explain what a Canadian amateur has to do to get his first license. First of all, there are only two classes: Amateur and Advanced. The first item is the following seven diagrams: (1) an AM and CW amateur receiver; (2) an AM and CW amateur transmitter; (3) a full wave tube-type or solid state power supply and necessary filters; (4) an overmodulation indicator; (5) a series or parallel wave trap; (6) a frequency measuring device (100 kHz crystal calibrator); and (7) a key click filter. A pass mark of 50% on diagrams is required. The theory exam consists of 50 questions, 25 on theory and 25 on rules and regulations. There are 4 different exams for those who write in groups, so the person beside you will get a different exam. The pass mark on theory exam is 70%. Many of the questions on our first exam appear on your Advanced or Extra class exam. The code exam is 10 wpm on both send and receive, and lasts for three minutes. The pass mark is 100%.

Our first license allows us to go on any portion of any of the HF amateur bands, but with CW privileges only. We are allowed voice on 6m and above. After six months we may apply for a 10m voice endorsement, but we must send in our logbook so that the DOC can be sure we have enough hours logged before it is approved.

Before we are allowed to write the Advanced exam, we must have held the first license for at least one year. The Advanced consists of a more stringent theory exam and a 15 wpm code exam (both send and receive, again for three minutes).

Power limits are 1000 Watts input for both classes, but on 160 and 432 there is considerably less allowed.

Garry Miller VE6AKW
Redcliff, Alberta
Canada

THE AVERAGE

I have been reading your magazine for about a year now, and overall I am very pleased with it. The articles are broad in scope and cater to many varied interests. However, from my own point of view, perhaps I can offer some constructive criticism.

I consider myself to be typical of the "average" ham. My station is fairly modest, and I operate SSB and CW, although I do have a desire to branch out into other areas. The trouble is, I really haven't seen the type of introductory articles in *73* that are both informative and easy to read. The articles I have seen are either at one extreme or the other: so basic that they offer virtually no concrete information, or so technical as to be above my head. I guess I'm referring specifically to RTTY and SSTV. Many excellent articles regarding other areas have appeared. How about some intro articles or even a series for guys like me?

You get input to your magazine from people like me who take the time to write. But what about all the other "silent" pens out there? Have you ever considered printing a detachable survey in an issue of *73*? I think there are a lot of guys out there who would like to see some really practical articles, e.g., how to build a steel tower using readily available materials, beam construction, etc.

I've been tempted to write a couple myself, but don't really know how to go about getting them published. So much for my criticisms. Regarding yours (of the ARRL), I think that while at times it is outspoken and unfounded, it *is* necessary. The ARRL *could* use some changes, and someone has to speak out. As an ARRL member, I can't recall them asking me if it was OK to build that new wing on their building. Perhaps the funds could have been put to better use elsewhere.

Maybe you don't agree with some of my ideas, but I think it is important that you get as much feedback about *73* and amateur radio as possible. And seriously, have you ever considered starting an organization analogous to the ARRL?

Gregg Corsello WB3CDK
Pittsburgh PA

Check our new "RTTY LOOP" column for beginning info, Gregg. — Ed.

RISQUÉ

A great deal has been published in *73* and several other amateur magazines concerning improper operation, questionable conduct, and risqué comments on the ham bands. However, a major problem has been ignored, or forgotten.

I have been a ham for almost a decade, and have heard just about everything on the bands, including a favorite (?) station in Newington CT, which choses to jump right on the West Virginia phone net, the night following the disaster in that area, only to announce, over the net control, that the frequency, 3990 kHz, was an emergency frequency. This is almost minor, though, compared with the problem of prospective hams being driven away by the "ham in a rut." Such operators consist of people like one I spoke with on the air the other night, who kept referring to "we" ("we are studying for our doctorate . . . we have been licensed for fifteen years," and so on). I honestly believed that the person with him (his wife) was also a ham, and was also studying for a doctorate. He sounded upset when I congratulated him and his wife on their achievement, as he must have thought everyone knew that "we" means "I".

Boy, am I weird!

Other all-time greats include "XYL" (how would a male operator like to be called XYM?), and the assumption that all hams are OMs. My wife Nancy recently received her Novice ticket, and has received subscription offers from *QST* and *Ham Radio* which opened with "Dear OM." Her name is not usually used to name anything but women or girls, right? And then they have the nerve to expect her to subscribe? Those letters were promptly filed, not by a person who objects to being called a person's wife, but by a lady who objects to being called "OM."

Then there is the usual "Hi-hi" which is often used for a laugh on phone. If a person responded to a joke while talking with you in person by saying "Hi-hi" you may be tempted to call for the men in the white uniforms. It is also rare that you hear a contact (pronounced kyoo-soh) which does not contain at least ten "Rah-gers," or someone saying "ahhhhhhhhhhhh," while trying to think of something else to say.

Nobody should be expected to use perfect grammar at all times, but if you record your half of your next few contacts on tape, you may find that you may be boring other people into oblivion! I tried this method, and cured myself of saying "uhh" (too many "uhhs" can drive a prospective ham away forever). I have heard from many a Novice who could not understand why the cliches used on the air have to be used at all. Do they?

Jerry E. Falletta WA2DWN
Elmira NY

No! You said it, Jerry. Unfortunately, many of the old CW timesavers have been applied to phone where they lose all their value. Let's speak English. – Ed.

KNEE JERK

How about a reasonable approach to the CB problem? At least they could try it while holding off a little while on the linear ban. I hope you will push this or some reasonable alternative.

Roger H. Taylor K9ALD
Champaign IL

Federal Communications Commission
Washington DC

Gentlemen:

I seldom write to any government agency, but your proposal for a ban on linear amplifiers capable of operating at 27 MHz, and for type acceptance of amateur equipment, has got to be one of the poorest thought-out regulations ever conceived. Let me point out a few of the negative aspects and then go on to make a much more workable suggestion.

First of all, you are punishing, both economically and otherwise, a large group of innocent people, namely amateur radio operators, for the lawbreaking activities of an entirely different group of people. You would also be perpetrating a serious negative effect on the various purposes of amateur radio, particularly Sec. 97.1b, and many of your previously restrictive regulations have made it difficult enough for amateurs to live up to that section. Despite this, virtually every major advance in the communications art has come from amateur radio, as you well know. Don't hamper us even more.

Your proposal is a typical "knee jerk" bureaucratic reaction to public and congressional pressure to do something even if it is wrong and shows a real lack of understanding of human psychology and the facts of life, as many of your past decisions have also shown (such as the $20 CB fee that started the mass illegal operations on CB). Your proposal will do nothing to solve the problem that now exists or affect it for the next ten years at least. There are millions of linears now in existence and in the hands of CB operators. You will simply put many more people to work in their basements turning out bootleg amplifiers. Your proposal will have the same success as prohibition – for the same reason. Many CB operators use high power amateur equipment without linears anyway, and if you think that type acceptance of equipment will prevent modification, regardless of any laws passed, you have your head in the sand and no real appreciation of the technical competence and ingenuity of the American people.

Your limited resources have already forced the abandonment of some type acceptance for CB. Why on earth do you want to add even more of a load when you can't handle what you have got already? There is a much simpler way. Make detection and punishment for illegal operations much more probable, in the following manner. Since it is in the interest of the broadcasting industry to eliminate unlawful interference, ask their cooperation in making a few "public service" announcements, briefly stating why it is in the public interest to maintain legal, proper, and interference-free use of the public airways for everyone's benefit. Give a toll-free number for people to call to report interference, and ask them to give as much information as possible. A few of these announcements, which you could start next week, would drastically reduce the problems immediately. Just the knowledge that the FCC was really serious about stopping it, and the availability of a number that would be used to pinpoint illegal operation, would have real effectiveness. Your publicized raids have had a real effect already. Use psychology to help you, instead of trying to row upstream against it. If I knew that every time I fired up an illegal transmitter several people within a block of me were going to tell the FCC where I was (within a few hundred feet), do you seriously think I would do so?

This is a real opportunity for a government bureau to show both Congress and the American people that they can act quickly and effectively against a real problem by enlisting the aid and cooperation of the people, rather than taking many months to impose ever more restrictive and unworkable regulations. The cost to both the government and the public would be minimal. Certainly the broadcast industry would be willing to carry a public service announcement by the FCC which regulates them and is definitely in their own interest at no cost to the government. Abraham Lincoln said that the government should do nothing for the people that they can do for themselves. It is about time the government realized the wisdom and value of that statement. The political benefits from this approach and the publicity from a visible cooperative effort between a government agency and the public can't help but benefit both. If you really want the interference problem solved in the foreseeable future, this is a swift and sure way to do it while punishing *only* those who are guilty. The publicity and fear of detection alone would stop over 90% of it and make the rest of your cleanup job infinitely easier.

Somewhat along the same lines, the opening of ten meters to the Technician license would strongly encourage the transfer of the millions of CB operators who are now becoming interested in radio communication to join the ranks of the amateurs. The jump from nothing to the General class license is just too big for most of them. There is no logical reason to restrict ten meters, now relatively empty, to General class licensees, with millions of people wanting to use it if they had a fighting chance of earning a license to do so. Amateur radio has shown a tremendous ability to be self-policing and there is something about earning that license that makes people want to use their privileges properly. You brought in incentive licensing, which has stymied amateur growth for 10 years; now use that concept in a positive way by making it easier and more attractive to those who are interested in long distance amateur operation to get started in the type of operation they desire on the (near) frequencies they are used to using. You started this whole CB mess and have compounded the problems with some very unwise and short-sighted decisions. Don't punish the wrong people with even more of the same.

Roger H. Taylor W9ALD
Champaign IL

UPSALA QUAD

When building a boomless, 3 band, single feeder quad, I faced the following problems:

1. Element lengths had to be adjustable, which meant adjustable fastening points on the spreaders (no stubs were used).
2. Because of the complex geometry caused by the common feedpoint, the corner points of the elements also had to be adjustable in order to divide stress between elements and assure a perfect quad shape.

As most magazine quad designs were found to use very primitive methods for element fastening, I found I had to work out my own solution. The following points should be noted:

NEW BOOK
THE NEW HOBBY COMPUTERS
see page 207

1. A hose clamp allows sliding the element along the spreader.
2. The element is made from soft plastic-covered stranded wire that slides, when necessary, relative to the piece of copperless glass/epoxy board.
3. A small stainless steel shackle (can be obtained from distributors of yachting equipment) allows complete removal of the element.

Erik Basilier SM5ASO
Florag. 15
S-752 28 Upsala
Sweden

EXPEDIENCE

Two articles in March *73* concerning MARS have caught my eye.

In the first, by Marc I. Leavey WA3AJR-ACM3AJR, it appears that Dr. Leavey is either not very familiar with Air Force MARS callsigns, or that Air Force MARS has made an error in mine. And I'm relatively certain that the latter is not the case.

Having been the Air Force State MARS Director for Kansas at the time the callsign changes were made, I became fairly familiar with them. AF MARS callsigns formerly were:

Prefix	Air Force
Wn	AFn
Kn	AFAn
WAn	AFBn
WBn	AFCn
WNn (Novice)	AFNn

When changed to the three letter prefix, the callsigns became:

Wn	AFWn
Kn	AFAn
WAn	AFBn
WBn	AFCn
WBn (Novice)	AFCn (Novice)

The most expedient route, that involving the least additional paperwork, was to change the Wn call to AFWn. During a time when paper costs have been rapidly increasing, Air Force MARS should be commended for its insight.

Novice calls remained unchanged until the FCC began issuing them WBn calls, at which time they also became AFCn.

In the second article, where it is stated, "There is a place where Technician class licensees can operate SSB on HF, and where Novices can operate voice on 2 meter FM," just what is there to prevent a Novice from now operating SSB on HF? I think that he may in Air Force MARS.

Further in this article, extra privileges, distinctive callsigns, and access to surplus equipment are alluded to. But if a potential member signs up in MARS solely to obtain excess property, he just may find himself storing excess government junk along with that that he can use. For in the past, some items have come out in that condition. Steps have been taken to rectify this situation, so it should be better in the future.

One final thought. The address given for further information is that of Army MARS only. Perhaps you should dig out the addresses for the other MARS services also, and present them. The AF MARS address is Command MARS Director, Hq AFCS/DOYR, Richards-Gebaur AFB MO 64030.

D. M. Casselman
WA0GSY/AFB0GSY
Conway Springs KS

KEYER UPDATE

You may be interested in the enclosed comments on "Build the World's Simplest Keyer." Re your May article, "Stop Timeouts!", I hope that you can join with us in trying to kill the idea of "10 minute timers." What the timer says is, "You just broke a regulation!" Better to set them at 8 minutes or 9 minutes. Of course, the timer with readout partially fixes this.

Another problem is short transmissions, since the other guy might take over and still be sending when your ID is due. Therefore, it is always best to give one sign when turning over. Also, note that phonetics generally are necessary with phone, to prevent misunderstanding the call.

E. H. Conklin K6KA
La Canada CA

Andy Ring
Yarmouth ME

I was interested in your article in *73 Magazine* (May). It may be that it can be simplified some more, and improved.

I note the relay, which is a "no-no" in CW because of the mushy key clicks when one gets contact bounce in them. Note *73* for September, 1965, ("Der Kleiner Keyer," by E. L. Klein). He simply used a PNP transistor, handling 150 volts, and keyed the transmitter grid circuit directly, with no relay. Cheaper than the relay, too!

Next, there are four pots. That makes it both complicated and expensive. For one thing, one might get rid of the "weight control," as being undesirable. Second, it may be possible to use only one pot to control both the dot and dash sides, possibly by using the right capacitors for the dots and dashes and the one pot. It appears that there are some alternatives to the second (dash) 555. One is to make it simply fill in the space between dots, as "Der Kleiner Keyer" does with a flip-flop. It seems that it can be arranged. The other alternative is to dispense with the 555 and use a flip-flop to do the filling in, with no adjustments at all.

"Kitty" is WB0DQW's latest ham convert.

As to VR1, it may not be required. I don't use any in the Kleiner keyer. If one uses a bridge rectifier and a 6.3 volt transformer, if available, one comes up with a pretty fair voltage to operate the keyer if no VR is used. The possible shortcoming might be not having completion of a suitable space after each dot or dash. Where there is a free running MV, this may be almost automatic, of course, within a letter. So putting in something for space between letters may be a complication.

You might look at the combination ICs which include a multivibrator. They may handle most of the keyer in one piece without a lot of external parts, if you find the right thing. It might be best to look at the CMOS availability anyhow, in order to cut the power drain down so far that you can go to a battery and throw away the on/off switch, remembering that the 2N398B keyer transistor runs off the exciter grid current, and does not get any power from the keyer.

E. H. Conklin K6KA

MORE TECH DEBATE

I am writing regarding the letter in your Feb. '77 issue, "Tech Relax," from L. N. Thompson. I apparently missed your editorial on the subject, but agree strongly with Mr. Thompson.

I feel that Technicians should be allowed use of SSB phone privileges on some parts of the 10-160 meter HF bands. If not, then I believe that the current 13 wpm code standard for General class should be reduced to 10 wpm. I have written the ARRL and the Chief of the Personal Radio Division concerning the above.

I urge everyone who feels that the present 13 wpm code speed is too high for the General license and that Technicians should be granted some SSB phone privileges on the HF bands to write the FCC and their congressmen and senators. I personally am sick and tired of hearing the older hams make statements like, "If they want higher privileges, let them work for them like we did." No wonder there is such a high dropout rate of Novices and Techs. No wonder so many Techs get on 2m FM and stay there. I admit that 2 meters is a busy band, but I have yet to hear it sounding like the CB frequencies — so that is no excuse for denying HF SSB phone privileges to Technicians!

Most of us have spent a lot of money on our hobby and equipment only to be denied use of it because of snobbish and archaic standards established many years ago.

Although my subscription just started this year, I am renewing for another year. Keep up the good work and the excellent articles.

John A. Magness III WD4BVU
Murray KY

HEX TO BINARY

Small point, but I'm curious why Joe Larson's letter (page 116, Feb. *73*) misquotes the figures he is using for illustration. Joffe's article uses the expression "3A7B"/Decimal 14971 (page 94, Holiday issue). Larson quotes this as "39BD"/Decimal 14781. Larson's points are well made, especially the conversion from hex to binary.

Bill Straley
Campbellsville KY

NO PR-40?

WA4KDC's operating system appearing in the March, 1977, I/O section of *73 Magazine* is fantastic! The only problem is that although everyone should have it, not everyone does have a PR-40 printer.

I thought you would be interested to know how I slightly modified the program to allow printout on my Teletype. The modification consists of modifying addresses beginning at 01EE with the following:

```
01EE BD E1D1
01F1 33
01F2 FE A014
01F5 39
```

Jim Huffman WA7SCB
Hufco, Inc.
Provo UT

KITTY

Enclosed are some photos which may be of interest to you. As you can see, my recruiting efforts for amateur radio do not stop at human beings. Kitty didn't think much of the key, though.

Thanks for your fine magazine. Keep up the good work!

Neil Preston WB0DQW
Kansas City MO

EARTHQUAKE

On the evening of Saturday the 5th of March, I assisted people searching for relatives in Romania during the recent earthquake there.

I wish to remark here that besides all kinds of complaints about the traffic on the upper part of the European 80 meter band, the traffic was handled in a very efficient way, with little amateur QRM. Everyone requested to stand by or QSY did so in the best possible way.

The network established traffic between Western European and Israeli stations, via Daniel YO8AHL in Iassy (located about 500 km north of Bucharest), to Bucharest, the capital city, where other amateurs and what was left of the telephone system did the rest. Also, I would like to thank the Yugoslavian stations that gave me assistance in finding the Romanian emergency network's frequency.

Jac Lirola F6CVU
Truchtersheim
France

THE HFERS

One of the acknowledged factors in the increasing proliferation of the so-called "Hfers" is the easy availability, without challenge, of amateur equipment to non-amateur persons. This accessibility has led to serious talk, even a Notice of Proposed Rule Making, of banning the sale of linear amplifiers capable of operation between 25 and 35 MHz.

It seems, therefore, that because of a few unscrupulous dealers eager to make a quick buck, many amateurs may either be unable to buy a 10 meter linear, or will have to pay a higher price to offset type acceptance costs. At least one dealer in Chicago and one in Milwaukee have no interest in whether a potential customer is or is not a licensed amateur. Spectronics in Chicago, on the other hand, states quite clearly, in ads and in their store, "No call, no sale."

It makes me proud that Art Houserholder and company have chosen to eschew a few extra sales to help preserve the integrity of the hobby. And, he enjoys my business as a result. My challenge to you is to do your part in preserving the integrity of the hobby by tightening up your already comprehensive advertising policy to refuse space to those dealers who do not restrict sales of amateur transmitting equipment to licensed amateurs.

Word of mouth is a pretty effective policing system (witness Trigger), and any advertiser not living up to the rules would be quickly exposed. Remember — today the linears, tomorrow the transceivers.

Rod Peterson WB9UQX
Carol Stream IL

THE NEW BREED

I am writing this letter to you and to those who would submit construction articles to you in the future. I would like to think that I am speaking for several thousand newcomers to amateur radio as well. Most of us cannot read schematics. Most of us do not have "junk boxes" stuffed with scrap suitable for use in construction projects. And many of us do not have a fully equipped machine shop at our disposal. The nearest electronic parts supplier is usually a Radio Shack store. And, we do not appreciate being referred to as the new breed of ham who buys his rig and plugs it in, but with such poorly illustrated construction articles, you don't leave us much choice. If a picture is worth a thousand words, then many of the projects could be shortened with the insertion of pictures showing the parts layout.

So please help us gain the expertise you have by submitting and publishing complete photos of your projects, parts lists, and suppliers of parts. Please be accurate in your details.

Think back to when you were a newcomer to amateur radio and help us get off to the right start.

John A. Magness III WD4BVU
Murray KY

P.S. I would like to buy any back issues you may still have. Please send list and price.

Right on, John. Old-timers, take note! Check any recent issue of 73 for a list of back issues. — Ed.

THE FAMILY

I just finished reading "HAM vs CB" in the May W2NSD/1 editorial. I am one of the many hams who came here through the CB *family*, as you called it. I received my membership papers to the family in February, 1976, and by March was so discouraged with the situation that I immediately contacted the Bluegrass Amateur Radio Club to get information on a Novice class they were holding. By July I held WA4RUW with Novice privileges. It's nearly a year later, and I am still a Novice, but I don't want to get back on 11 meters just to operate phone. You feel that CB is in a different family and hams have no business messing in those affairs — I agree partially. But when I go down to 10 meters to look for a rare 10m QSO, all I find is "Harry Top" talking to "Junk Yard Dog," on 28.169 MHz! Do you still feel like we shouldn't mess in those affairs? Being an ex-CBer, I used the old tactic of more power and zero beat, and started calling CQ on frequency. The reaction was surprising — more power and four letter words! The two handles used are fictitious, but the incidents are true. With 11 and 10 meters so close, CB is a close cousin to ham, and I feel there are some family affairs we need to concern ourselves with.

Bob Cornett WA4RUW
Lexington KY

11M TO 10M

I read with great pleasure the article by Bob Wilder ("CB to 10 . . . A Legal Alternative," May, 1977), and strongly endorse his plea to encourage the use of CB transceivers on ten meters. I would, however, suggest one major consideration which I think should be worthy of serious thought, at least as a viable alternative: the use of an external transverter, rather than internal modification. A number of transverter articles for VHF bands have been published. The advantages of this approach are numerous: no modifications to the CB set to destroy its resalability; no tampering with the transmitter section rendering the set illegal for further CB use; simple external switching would provide alternate CB or ten meter use. The band plan suggested by Bob Wilder would still maintain its integrity, as the heterodyning transverter would still provide the ten kHz incremental tuning which he suggests. A standardized (hint to prospective manufacturers) transverter would be applicable to any CB transceiver, and complicated internal synthesizer formulas would no longer be a consideration. See you on ten!

Bob Grove WA4PYQ
Davie FL

OSCAR ORBITS

A common assumption regarding the OSCAR satellites is that the period (time of one orbit) and increment (number of degrees west the satellite appears to move) both remain constant. Several programs appearing in *73 Magazine* recently use this principle to calculate the position of the satellites by inputting a starting position (equatorial crossing point) and time, and incrementing the constant interval for the succeeding orbits.

I wrote a simple BASIC program to do exactly this, and everything looked fine until I ran out the calculations to the end of the year (4500 or so orbits). There was a small but appreciable error which I couldn't account for when I compared my results with the book of orbital times published by Skip Reymann W6PAJ. This book was compiled from data computed by Tom Clark WA3LND, so I wrote him. To quote his note to me, "Since the period and orbital longitude increment are *not* constant, . . . I provided W6PAJ with weekly period/longitude increment data, but he chose to print one value for the year."

So, programmers beware — your results will be close, and will be usable, but they won't be entirely correct.

Warren Munro KH6GSH
Aiea HI

CHEAPER THAN EVER

I have subscribed to *73* for about four months now, and I have come to conclude that it is the best amateur radio magazine on the market. When I pick up a magazine, I expect to see articles that I can get some good reading out of and that I can learn a thing or two from.

I really enjoy your I/O section and I hope it will stay the way it is even though the new magazine *Kilobaud* has come out. I really wish I could subscribe to *KB* but my budget doesn't allow it.

I am really interested in WA0TSY's idea about converting CBs to 10 meters, since I used to be an avid CBer and have some equipment around that I am willing to make the switch with. I hope others will see this idea so that it may catch on, as CBs are cheaper than ever, and this would be an economical way to get on 10 meters. Maybe you could include some articles on this idea and conversion details in your upcoming issues of *73*.

John H. Peeler WA4UYI
Denver TN

They have started coming, John. See last month's issue. — Ed.

PC REFORM

A hearty "well done" to your staff for the articles on printed circuitry! I just had a chance to finish reading both of them and I must say I wish I could have read these articles three years ago when I started working with printed circuitry. I had to develop my own methods and spend an indecent amount of money to get good results. Your readers may not realize how difficult it normally is to get good information on PC fabrication. The majority of the trade manuals are as vague on such items as exposure times and others as a politician is on political reform. And many magazine articles leave out critical information, to boot! Thanks again for putting a light at the end of the tunnel!

I can't resist putting my two cents worth in. If you are working with PC fabrication for the first time, follow each step carefully and use fresh materials. Then, after you are successful, you can take shortcuts. If you start with the shortcuts, you will probably end up with a bad board and no idea of what went wrong. And that means confusion!

If you have a problem with the resist washing off the board during the etching process, this means either that the copper was too dirty or the copper was too smooth. You can often solve this problem on the next try by drying the exposed and developed board in a warm oven. Once the moisture evaporates, the resist tends to stick tight. Try it!

NEW BOOK

RTTY Handbook

RTTY HANDBOOK
see page 205

Let me wrap this thing up by quoting a phrase I heard from many a PC professional fabricator: "You can't make PCs for under about $100,000!"

Gary McClellan
General Manager
McClellan and Company
La Habra CA

THE RUB

I enjoy the contents of *73* except for one thing. Whenever *QST* is mentioned, it usually gets its nose rubbed in the dirt. Doing that does not help your magazine. If anything, it detracts from your publication. Perhaps jealousy is the motive? Why not improve your own magazine by omitting the derogatory remarks about *QST*?

David Keith WB0GUE
Marble Rock IA

None of the other publications seem to have any opinion at all, David. If your only suggestion for improving 73 is the elimination of controversy, I guess we are doing pretty well. — Ed.

KUDOS 1

While I am spending postage to write about another matter, I thought I would let you know about the quick efficient service that Hamtronics, Trevose PA provides — time after time!

Edwin Steeble K3IXD
Glenwood MD

KUDOS 2

I bought a Gold Line coax switch at a local radio store only to find out that it didn't have a connection on position number two. So I wrote Gold Line a letter explaining the difficulty. A few days later I received a new switch from them, postpaid. Just thought that I would let you in on it, and the other readers, too.

Dan Renfro WA4PXV
Mt. Pleasant NC

BE MY GUEST

visiting views from around the globe

Dayton: Reporter's Notebook

Dayton 1977 was the biggest yet, with thousands more than the organizers expected. At deadline, the estimate of attendance was well over 16,000, although ticket numbers higher than that were heard over the hamvention PA during the closing hours. It was the ham radio event of the year in several ways – the growth of the hobby was obvious as crowds six and seven deep kept the booths busy most of the day Saturday. A three hour traffic jam around the Hara Arena earlier in the day forecast the afternoon crunch. Dayton's flea market was everything it was promised to be . . . acres and acres, with waiting lines in the early hours. (The local repeaters had warned in advance that flea market types better get plenty of sleep Friday night, so they could get a good spot or catch some good deals.) They opened the flea market doors at 6 am both Saturday and Sunday!

There were over a hundred exhibitors. Many said there were more dealers than manufacturers this year, showing less new equipment than expected. Dentron Radio, for example, put off introduction of their new transceivers until fall, while Drake was ready with their new UV-3 triband VHF/UHF transceiver. The radio offers a fully synthesized FM system covering 2m, 220 MHz, and 450 MHz, 25 Watts output, plus a variety of accessories. The unit can be separated from the power supply and main section, for remoting the control head. The Drake uses a PLL system for frequency control, with digital readout. There was also the return of the Signal One transceiver, from yet another manufacturer, Signal One Corporation. The price is up to $3999.95, but company representatives say the new CX-11A is totally redesigned (although the appearance of the rig remains much the same).

One of the Dayton VIPs was Carl Mosley of Mosley Antenna fame.

There were also the new CIR transceivers, which feature digital tuning of the 80 through 10m bands. Two switches control frequency, one a fast attack, the other a slow scan rate. The size is very small, considering the fact that the Astro 200 is rated at 100 Watts output. Accessories include a station operating console, speaker, and ac supply (the CIR normally runs on 12 to 14 V dc). CushCraft introduced a new line of HF trap vertical antennas, while Dentron showed a new 1200 Watt HF amplifier (half the MLA-2500 package, but without 160m coverage) and a new tuner to match the MLA series, complete with built-in 250 W dummy load and twin front panel wattmeters for continuous monitoring of forward and reflected power.

Among the more interesting accessories introduced at Dayton was RF Engineering's DFD-100 digital frequency display for use with Collins, Drake, Kenwood, Atlas, and Swan equipment. Readout is accurate to the nearest 100 Hz without band switching or mode switching. Hookup is easy, especially for Drake or Collins gear where the necessary frequencies are available at the back panel of the radio. Spectronics showed a unique outboard device for the popular Icom 22S 2m rig. It's called the Specscan, and it does a score of things, including full scan of the 146-147 MHz band in 15 kHz steps and VARI-SCAN™ which allows full scanning control of the scan rate in either direction. Power consumption is less than 500 mA, and automatic channel lockout lets you scan past any portion of the band. All this can be done without major surgery or giving up normal operation of the 22S.

Heath had a prototype of their new CW transmitter, which matches the HR-1680 receiver, while KLM was showing off their newly acquired 6m SSB rig, a National (of Japan) import. It is similar in style to the Hy-Gain 3750 HF transceiver, which is also made by National in Japan. Atlas, aside from enjoying the high demand for their popular 210X and 215X transceivers, showed their new 350-XL transceiver, although they were not expected to be available until early summer. Robot kept a crowd with videotape of NBC correspondent (and hamvention banquet speaker) Roy Neal K6DUE explaining SSTV to a national TV audience via a Today Show segment last winter. The story covered the N6V operation during the Mariner mission to Mars and marked the first time that both ends of an amateur QSO were broadcast live on national TV. Kenwood kept everybody wondering how they could afford a new TS-820 transceiver. The icing on the cake was Saturday's visit of Neil Rapp WB9VPG, the world's youngest licensed ham. Kenwood had given Neil a TS-520 for his 6th birthday, and his appearance at the Kenwood booth only added to the crunch around the company's display.

> **"It was the ham radio event of the year in several ways – the new growth of the hobby was obvious . . ."**

On the whole, dealers outnumbered manufacturers, and it was clearly a buyer's market. Prices were slashed early, with some dealers complaining that it would have been better to stay home and sell their goods without the pressure of the price cuts. There were also grumblings about the hours booths were open, as many exhibitors returned to their motels with sore feet and mild cases of exhaustion each night of the hamvention. While the exhibitors were resting, convention goers were treated to dozens of informal gatherings, ranging from the annual "FM Bash," to an ATVers' session. The parties went well into the night.

The forums were well attended, with something for everyone. The biggest turnout was, of course, for the FCC forum, which proved to be a bit disappointing. FCC Personal Radio Chief John Johnston did not take questions, presumably because of that Federal Court ruling on the Commission's alleged failure to follow its own rule making procedures. The ruling ("Briefs," June *73*) limits informal comments, such as hamfest bull sessions, without a written record for the appropriate public file.

In his talk, Johnston was strongly critical of high power amplifiers, knocking *QST* for publishing a recent construction article on the subject, and terming "brazen" the sale of a 10,000 Watt linear in the hamvention flea market. Johnston was preaching QRP, and, in light of the Carter Administration's energy proposals, his warning that "the day of the overpowered bully operator" must be numbered rang especially true. (Full details of the FCC forum can be found elsewhere in this issue.)

On WARC, amateur radio advisory

> **"A big part of the Dayton story was what happened outside the Hara, on the roads into the city, along the interstates and in the air terminals, where amateurs flocked for transportation to Ohio . . ."**

committee chairman Peter Hurd K4NSS presented a half hour long explanation of what the frequency conference is all about and how the US is preparing for it. Hurd was thin on details about what is actually happening, although there were some hints — his reference to the Jack Anderson column, and the "tremendous interest" of the civil sector in the rf spectrum as a "gold mine" over the long term. (Hurd told the forum that the Anderson column could be traced to those same interests.)

He also warned that there had been a lack of reaction to the WARC proposals. "The concrete is beginning to harden on these proposals," Hurd said, "and comments are very important." Hurd identified the key issues ahead as a definition of what criteria would be acceptable for sharing bands, and what to do about 220 MHz. "The committee would appreciate your input on why we need 220 MHz," he said, "and why we can't share it with Class E CB."

As for keeping frequencies, Hurd showed several charts illustrating how amateur radio's position has changed over the years. In 1935, for example, the amateur population dominated the stations on the air in the US, whereas there is but a small percentage of hams (as compared to other users) on the air today. Hurd put the committee's feelings this way: "We're not on the air because of numbers, but rather because of the quality of the service we provide."

"I nearly drove off the road on the way home, when Dave WD8CYV drove by on his motorcycle holding both hands in the air and showing the classic 52 signal . . ."

He went on to warn that we have to grow up into the 10 GHz band and beyond, to look 20 years down the road and plan for the future of amateur radio. "It's a long-term investment," said Hurd, "with the viability of today's bands limited to a very real point by how convinced the decision-makers are as to how well we're using those frequencies." Hurd did not appear optimistic, in great contrast to the League official who was telling convention-goers that "WARC and Jack Anderson are under control . . . we're right on top of it . . ." Hurd's advice to amateurs worried about WARC? "Remember that every frequency is an international one — whether it be 2m or 20m, the internationals are listening." Hurd pointed out that foreign governments maintain offices in major US cities, thus opening the door to reports home on the use of virtually every band. He also noted that the next step in WARC would be the release of a 5th notice from the FCC, due out by late May.

A big part of the Dayton story was what happened outside the Hara, on the roads into the city, along the interstates and in the air terminals, where amateurs flocked for transportation to Ohio. On Interstate 90, horns would turn to CW, with "52 . . . 52," or a simple "73" exchanged as hams passed. I nearly drove off the road on the way home, as Dave WD8CYV drove by on his motorcycle holding both hands in the air and showing the classic 52 signal! But it wasn't all fun on the highways home, as one group met disaster near Philadelphia. Driving in a sports car, they mixed it up with some big trucks, reportedly killing the driver and seriously injuring two passengers.

Dayton, the city, lived up to what was advertised — the Air Force Museum was super, the motels were generally good, and the town does shut down tight promptly at 6 pm (or shortly thereafter). Getting dinner after a day's work at the hamvention proved to be pretty rough. The first night we got hopelessly lost without a radio (better not take it, I was advised, since it will probably get ripped off), and the second night we waited in line at a restaurant for nearly an hour before catching on to the fact that the hostess needed $25 or $30 stuffed in her hand before we could get seated. We left instead.

The hamvention itself seemed to have outgrown its bounds . . . the traffic was intense, the hours long, and the crowd huge. It looks like the Dayton club is going to consider moving from the Hara next year, possibly to a fairgrounds nearby. But Dayton is still the biggest . . . it was great fun, although it may just be getting too big for its own good.

Warren Elly WA1GUD
Assistant Editor

QSLs!
see page 204
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W2NSD/1

Dayton: FCC Forum

If there was a theme in the FCC forum at Dayton, it was probably QRP. Personal Radio Chief John Johnston K3BNS offered some strong words about high power operation, even going so far as to criticize the ARRL for publishing a recent linear amplifier construction article in *QST*. Johnston warned that the day of the "overpowered bully operator" must come to an end, with more work on QRP and developing new ways to measure power. He called the search for new power-measuring devices the greatest contribution amateurs could make to the state of the art.

With FCC staffers taking notes on the sidelines, Johnston came as close as possible to covering recent rule making proposals, without crossing the line on *ex parte* comments as prohibited in a recent federal court decision. ("Briefs," June *73*.) He said the FCC staff had been "under the gun" to deregulate amateur radio by Commission order. In fact, said Johnston, that was his first job after taking over as Personal Radio Division chief. Noting that 1976 marked the relaxation of more regulations affecting the amateur service than any other single year in history, Johnston said amateur radio had turned around, with more growth than the Gettysburg FCC staff can handle.

The growth has created new problems, according to Johnston, problems that are so serious that the licensing structure of amateur radio may have to be changed as a practical matter. License applications were up 50 percent last year, at a rate of around 12,000 per month . . . that's four thousand more applications than the Gettysburg staff can be expected to process. This year applications are arriving at *3 times* the rate that Gettysburg can handle, and 13 staffers have been moved from the CB section to cover the amateur overflow. That brought applause at the Dayton forum, but Johnston cautioned that it was not exactly something to cheer about since he'd be forced by budget considerations to put the 13 workers back on CB tickets in early June.

The licensing boom may be great for ham radio, but it represents a serious emergency for the FCC. Counting repeater applications alone, there is a backlog of over 1300 waiting for callsigns. A closed season has been called on secondary station licenses, and the Commission is looking at the Novice class license as a time-consuming wrench in the works. As Johnston put it, "Amateur applications must drop off, or classes of license will have to be simplified to increase production." "Otherwise," he added, "we will sink in a sea of applications and complaints." Ironically, at that point in the forum the lights went out. Johnston remarked that he couldn't even read the jokes . . . but what he was saying was no joking matter.

The Gettysburg computer was portrayed as a red tape monster, requiring 40 different programs just to grant one amateur license! In the case of Novice tickets, the granting of a license is only the last step in a complicated process which includes checking the credentials of volunteeer examiners, certification of code proficiency, mailing of the written exam, plus keeping track of the exam papers until they are returned. Johnston put it bluntly, saying that Gettysburg soon won't be able to do both the Novice applications and all the other classes. A new computer (and the associated programs) are due next year to replace the rental unit currently in use, and some innovations are possible (like 1 x 3 for Advanced class), but the backlog remains.

Then it was on to the latest bombshell from Washington — the first new regulations from Docket 20777 (bandwidth). Johnston explained that the new limits (40 dB below 30 MHz, 60 dB above) on harmonics and spurs were a reflection of international agreements designed to replace the old "according to good engineering practice" provisions of the current rules. Johnston contends that most manufacturers can meet the new specifications with current equipment, but he warned that it was high time for amateur radio operators to start putting higher technical standards on their equipment and operations. Johnston noted that there had been several petitions for reconsideration from the ARRL and manufacturers claiming severe business consequences, but he did not speculate on how successful the delay tactics would be. (At a meeting of ARMA, the Amateur Radio Manufacturer's Association, President Dennis Had ruled out any postponement, pointing instead to an ARMA-proposed grandfather clause designed to ease the impact of 20777.)

On callsigns, Johnston told the crowd that all W/K 1 x 2 calls were gone in the 4th and 6th districts. What Johnston did not volunteer (or did not know at the time) was that the chief of the FCC's Special Licensing Division in Gettysburg had been indicted on four bribery counts for allegedly taking $100 payments in exchange for 1 x 2 amateur calls. (See "Briefs," this issue.) Johnston, noting that all Extra class licensees will be eligible for 1 x 2s in July '77, said that the major problem in the phased changeover had been allowing people to choose their own calls. Many interpreted that to mean no more listings of first, second, or third choices for future callsign availabilities.

Johnston also spoke about the long-awaited comprehensive code exams, which FCC officials assure us are in effect by now at all offices. At Dayton, the word was that all district engineers would be using the new multiple choice CW tests within "days."

> **"The Gettysburg computer was portrayed as a red tape monster, requiring 40 different programs just to grant one amateur license . . ."**

There were no questions asked of Johnston, as has been traditional at Dayton, but he did remain after the forum to field some from individuals. Overall, the FCC's most important man (from an amateur view) left quite a few questions unanswered, at least from the podium. But there were enough strong statements in his remarks to give you the feeling that deregulation and more changes in the amateur service can't be far away. Prime targets seem to be power amplifiers and the licensing structure.

Warren Elly WA1GUD
Assistant Editor

De WA3ETD

PERSONAL SAFETY

More and more hams are becoming active on UHF. If you don't believe it, check out the advertising in the pages of *73*. KLM and VHF Engineering are two notable firms that deal almost exclusively in VHF and UHF gear. The number of outfits that provide some sort of 2m gear is amazing. It has been said that at least fifty percent of the active amateur population is on 2m; I don't doubt it for one moment. The trend in the VHF/UHF tinkerers' community is to reach higher and higher in frequency. At least one progressive company, Microwave Associates, has responded by providing a specially designed microwave transceiver for the ham market. (The product is the 10.5 GHz Gunnplexer, discussed in May's New Products section.) If you are not an OSCAR satellite fan, listen in on the 2m downlink some evening if you have a tunable rig for two meters. Any old omnidirectional antenna will do — those Mode B signals are pretty strong! After chastising yourself for not being on OSCAR, recall that each of those two meter signals was the result of a 432 MHz uplink signal, and if 432 is not UHF, I don't know what is! Many OSCAR users probably do not consider themselves UHF enthusiasts, and are more concerned with the communications aspect of their hobby. The point of all this is that daily more and more hams are using UHF. This trend will most certainly continue as more manufacturers jump into the ring. And don't forget the new OSCAR launch this fall — the one with a 2m uplink and 435 MHz downlink — the first bird to actually use an amateur satellite frequency!

As with any new band, there are precautions to observe. Remember the first time you were on two, and ran 250 feet of war surplus RG-58 up to the old horizontal beam? Didn't get too far, huh! Not only does UHF have its share of technical problems, but also there are questions of personal safety that must be observed.

Most hams have seen or used the now familiar "microwave oven," a device that uses high frequency energy to heat organic material from the "inside out." The relationship between heating effect and rf frequency is not agreed upon by the experts, but one thing is for sure — UHF energy from an amateur transmitter in the 420 MHz band and up can be dangerous in some instances. The problem results when tissues are heated by the radiation faster than can be compensated for by normal blood flow. The eyes are particularly sensitive to UHF radiation. The experts also do not agree on what "power density" can cause damage to human tissue and at what frequency the power must be applied, etc. Industry currently accepts a standard stating that a power density of 10 mW/cm^2 is safe, that is, at the point of exposure the amount of energy passing through a square centimeter in space is less than 10 mW. There has been considerable pressure from medical and research groups to lower that figure, as there has been evidence that eye damage can occur at considerably lower power densities. No one knows for sure. For additional information concerning the effects of microwave radiation and research into the problem, refer to an excellent series, "Microwaves," by Paul Brodeur, that appeared in the Dec. 13 and Dec. 20, 1976, issues of *The New Yorker* magazine. Back to amateur transmitters!

It should be obvious that any amateur UHF transmitter capable of generating power is potentially dangerous. Power density is enhanced by beam antenna systems, dishes, horns, or whatever device is employed to focus the transmitted signal. One should never needlessly expose oneself to UHF radiation. Do not stand in front of a beam operating at 420 MHz and especially avoid exposing the head. Under no circumstances look into the end of a horn or waveguide antenna while the transmitter is operating. Why take a chance when so little is known about the subject of heating and neurological effects?

Microwave Associates Gunnplexers are bound to become increasingly popular. I have been doing considerable experimenting with a pair of these devices and employ a simple method to avoid exposure. The mobile "radar detectors" which are currently transcending CB radios in popularity are broadband devices and will respond with a whistle or whine to almost *any* microwave radiation below 20 GHz. I keep an el-cheapo variety detector activated in the room when experimenting with Gunnplexers, and does it go off when the 'plexer is fired up! It sure keeps me aware when microwaves are present, even though the devices are "aimed" away from myself and anyone else around. One night, Rich Force WB1ASL, *73*'s publications editor, and myself ran a test with a Gunnplexer and the radar detector. The detector went off at distances over 200 yards away from the source of microwaves, and I ran out of space to back up. If you don't feel like springing for a detector, build a simple device using a UHF diode — be smart!

DOES THE FCC KNOW ABOUT MICROWAVES?

A silly question, you say! I received a call late last Friday from a concerned research group on the West Coast. It is common knowledge that a new Citizens Band is proposed for the 900 MHz region. (Microwave ovens function with energy in that band!) Some people are concerned that personal safety may not be the ultimate goal of the Personal Communications Department (FCC). Imagine running 100 Watts into a well-designed beam at 900 MHz. Could get warm, and that's what we are concerned about!

This morning I called Personal Communications Engineering and talked to Mr. Will McGibbon. It turns out that the Chief Engineer, Mr. Ray Spence, was concerned enough with the problem of biological radiation effects that he asked Mr. McGibbon to research the problem. The FCC is well aware of potential problems, and I was assured that the biological question will be addressed before any new bands are opened for public use. There are tons of literature and reports to wade through, culminating in an international convention to be held this fall. Hopefully the question of "radiation standards" will be resolved. There is considerable evidence that the 10 mW/cm^2 standard may be unsafe, although much of the supporting research was conducted by the Russians. Many of the experiments have not been able to be duplicated. I am personally interested in this subject. All UHF experimenters should be. This column will pass along information as it becomes available, but for a primer, try *The New Yorker* articles.

AUTHORS TAKE NOTE

The editorial staff at *73* is busier than ever! Everyone on the *73* end of things has at least two functions, ranging all the way from "pasting up" articles to insuring that authors get paid for their work as fast as possible. The phone also rings several times a day with calls from authors wondering what the situation is with their articles. Possibly a bit of explanation about our system will be helpful at this time.

Articles arrive at a rate of four or five a day, on the average, and are opened and dated by me. Hopefully, within the week they are read, and, if accepted, priced. Rejected articles are immediately returned with no funny business. At the time of acceptance I fill out and mail a postcard indicating acceptance. The card states that "a check and author's proofs are forthcoming." It should say ". . . forthcoming in four to six weeks," as our production and financial people work on a monthly cycle. Once the card is received, you can expect a check in about a month, maybe sooner if it's the end of our cycle, and author's proof sheets, which indicate how your article will look in print. It is very important to carefully check the proof sheets for errors, especially in the schematics and diagrams. Your integrity is at stake as well as ours! Please do not phone two weeks after sending your article wondering why your check has not been mailed — it's on the way! As you know, *73* pays authors upon acceptance, which is unusual in this field. We try our best to publish all material as space permits!

Writing for *73* is easy and fun! There is no better way to partially finance your hobby and become published at the same time! If you have been sitting on a pet project, let us know about it — share your inventiveness with others. Send an SASE for a copy of "How To Write For *73*," which outlines the rules to follow when preparing your manuscript. Please, NO handwritten material. If you can't type, have your article typed — it's cheap. After reading for six or eight hours every day, you would understand why typing is important — thanks!

COMPUTERMANIA

The biggest hobby computer trade show of them all is being held on August 25-27. The place is the Commonwealth Pier in Boston. Sponsored by *Kilobaud* (you have a subscription, right?), the show will cater to microcomputer hobbyists, calculator freaks, the mini crowd, and the small businessman requiring an insight into small systems. All the micro systems will be represented on the exhibit floor, and a steady stream of forums and demos by the manufacturers will be offered to keep you posted on the micro industry. Mark your calendar, and stay tuned to *73* for information as it becomes available.

John Molnar WA3ETD
Executive Editor

Make S-864 Law!

Jim Beedle W9NIN and Art Reis WB9YOB have prepared a guide on how to write your congressmen and senators in support of the Goldwater RFI Bill, and its counterpart in the house. They suggest you handwrite your letters, be concise, and stick to just one issue — S-864. See "Briefs" for a listing of key senators. — Ed.

WHY S-864 MUST BE MADE LAW

I. Constitutional Reasons. The Constitution was designed, among other reasons, to protect what the Declaration of Independence referred to as "certain inalienable rights," including the rights to "Life, Liberty, and the Pursuit of Happiness." And, the First Amendment goes a long way toward fulfilling that protection. Precedent and common sense have further established that "one's rights end where another's nose begins."

As long as the activities of one are not at fault in denying the rights of others, as mentioned above, there is nothing truly illegal about them. Specifically, amateur radio operators and Citizens Banders, as long as their transmitting equipment is designed, adjusted, and filtered properly for the prevention of RFI, have every Constitutional right to be on the air. Likewise, their neighbor has every right to watch his TV or listen to the radio or stereo in peace, as long as he doesn't infringe on the rights of others (i.e., too loud for the neighbors). However, the makers of such home electronic equipment have misused their right to pursue their happiness by making their wares as cheaply and as shoddily as possible in certain respects, while selling them for whatever the market will bear. This is not inherently evil, except insofar as their pursuit of happiness infringes upon the rights of both the consumer and the radio operator/hobbyist to enjoy their separate avocations in peace and harmony in the same neighborhood. Then it's time to do something about it. With 20 million CB sets and 300,000 amateur radio sets out there, they have to put them somewhere. And that includes your neighborhood. The personal communications explosion says it loud and clear: The time is now to clean it up!

II. The Government. It's time to save the FCC. Like many Federal agencies, the FCC is underfunded, understaffed, and overworked. In 1974, the Commission received over 40,000 RFI complaints from consumers. When these were carefully analyzed, ninety percent were found to be the fault of the design and/or construction of the equipment interfered with, and not of the transmitters involved. In 1977, the FCC expects to receive 200,000 of these complaints. Considering how small the Commission's kitty is, couldn't some of that be used for better purposes than chasing down RFI complaints? We think so.

III. The Consumer. Joe Consumer is a babe in the woods on this issue, and in one major respect, he is being ripped off. But, unfortunately, he is blaming the wrong guy. When Joe spends a lot of his hard-earned money on a new TV, stereo, or whatever, he almost expects that it be made by God, and that it is perfect. Well, we have news. It is not. If the amateur radio or CB buff down the street tears up the picture and/or sound, Joe Consumer's logic says: "It didn't happen before he got on the air. It must be his fault." Joe doesn't know what makes his little box work. All he cares about is whether the picture or sound is there, in good quality. He doesn't realize that it takes something else besides what meets the eye or ear to make his equipment a truly quality device. But, for the money that they've just extracted from him, the manufacturer of that equipment should have seen to that end of it, so that Joe won't have to worry about it. We think that it's time he did.

Oh, yes, the television manufacturers have long offered filters, free, to anyone with a TVI problem. But they've never made any publicity about it, so chances are good that Joe knows nothing about it, or how to get such a filter. If in the off chance he does get the filter, then why does Joe have to pay the $20 or so installation fee, after shelling out all that other dough to get the set in the first place? And what if the problem were caused by lack of shielding, which a filter can't fix? What does all this tell you about how the manufacturers feel about their products? And, what about the RFI problems of other types of consumer electronic equipment? What's being done for the consumer by them? Do you see why we're fighting to make the manufacturers clean up their act, before the consumer buys it?

IV. Radio Operator/Hobbyist. He's in the vise here. When he operates, even if he's clean, he's hated by someone in his neighborhood. Joe Consumer casts him as the villain in this game, when 90% of the time he's not. Bill Operator may not be interfering with his own TV or stereo (which can prove that he's "clean"), but that cuts no mustard with Joe Consumer down the street. If this sort of thing keeps up, Bill Operator may face some nasty situations, such as vandalism against his equipment, or worse, local nuisance ordinances, local tower bans, or a total ban on his operations by local authorities. And, nine chances out of ten, it's not his fault. It's not fair, and we believe that a court test would eventually support Bill's right to operate in peace. But, must we go through that? No . . . not if S-864 passes.

V. The Manufacturer. At least one manufacturer now puts a high pass filter at the front end of its TV sets. Hurray for them, whoever they are. But, for the rest, it's still business as usual. Not that any of them haven't done something about this. Another major TV manufacturer has researched the cost per degree of RFI protection built into a TV set. Our sources tell us that it comes out to about a dollar a set. Obviously, that makes such protection economically feasible for Joe Consumer. So, why don't they? Because they haven't been told to, yet!

Over the past few years, metal shielding has disappeared from the American TV set. Its place has been taken by plastic. Couple this with the coming of the transistor, which is much more RFI-prone than vacuum tubes, and you have a major RFI problem. Add in poorly designed circuitry, built only with low cost in mind, without the proper design to get rid of strong adjacent local signals (such as Bill Operator), and maybe an old, corroded antenna with lead-in, and you have the makings of disaster. Period.

You know, there are other countries that don't put up with this sort of situation. Japan and Germany require that all home entertainment equipment made for domestic sale be RFI resistant. There, the RFI problem is but a tiny fraction of what it is in this country. And the cost to the consumer is little more than it is here. If it works there, it will work here.

And the manufacturers know that. And they will continue to fight such improvements, just as they did in 1964, when the All-Channel Set Law was being debated. The manufacturers screamed that the prices of TVs would be pushed out of sight if the law passed. It did pass; the price rise was very moderate. The situation is no different here, with S-864. Only the stakes are higher. So, why not support it?

VI. The Broadcaster. Jim Broadcaster is involved in this fight from several angles. The low band VHF TV broadcaster, particularly, has a problem with local signals from six meter amateur radio operations, and in some cases, signals from the FM broadcast band may wipe him out. If a certain TV's i-f stage is unshielded, a strong local signal may enter there and wipe out all reception of all TV channels. AM broadcasters get it from two directions. Spurious radiation given off by nearby TV sets operating with poorly designed sweep circuitry and wide-open cabinets clobber their signals in the fringe areas of their coverage — or even closer in. Meanwhile, the AMer himself may interfere with a PA system being used near his transmitter site.

All broadcasters are affected if the radios or TVs receiving their stations are blown away by a strong local signal coming into the audio stages of the receiver. Then the local signal will wipe out the broadcaster's audio, and Joe Consumer may end up playing cribbage rather than listening to your ad messages.

A major problem for the AM broadcaster is industrial noise, and we believe now that much of it is caused by radio frequency emissions from home TV sets. It never occurred to you, did it?

Remember: As long as the amateur radio operator or CBer is running a "clean" rig, he is not the one to be condemned. Go after the guy who built the TV, stereo, whatever is being interfered with. He's ripping you off! Support S-864.

WHAT BILL S-864 IS

It is simply an amendment to the Communications Act of 1934, which allows the FCC to set standards for the manufacture of consumer electronic equipment, with regard to its susceptibility to interference from nearby transmitters which are properly licensed, designed, and operated. That means that the passage of this legislation into law is only the first of two steps needed to make this whole problem of RFI go away. Later, we will offer, in petition form, a set of standards for the FCC's consideration, and again we will ask your support to put an end to this problem once and for all.

TO ALL AMATEUR RADIO OPERATORS AND CBERS

S-864 must become law if we are to remove a major threat to both personal communications and the right to view and listen in this country. Therefore, you are strongly urged to (1) write your representatives in Washington, demanding their support of Bill S-864 and its House counterpart. Feel quite free to use any and all arguments used here. Your own words will help. And (2) pass this information on to a friend, neighbor, or relative.

Remember, if you don't support this legislation, and it fails, and you later have an interference problem with your new, TV, stereo, amateur or CB rig, you have no one but yourself to blame. Don't put it off, write to your elected representatives now!

Jim Beedle W9NIN
Hanover Park IL
Art Reis WB9YOB
Wonder Lake IL

Continued

The Duty

With news of a US Customs Court decision ordering higher import duties on Japanese imports (see "Briefs"), the stage has been set for another round in the debate over foreign manufactured electronics goods. But not all American companies favor higher import duties, especially those who use foreign components, as illustrated by this news release from National Semiconductor. – Ed.

Mr. E. Floyd Kvamme, vice president and general manager of National Semiconductor Corporation's semiconductor division, appeared in Washington on March 15, 1977 to testify at US International Trade Commission hearings. The ITC is conducting an investigation for Congress regarding the possible economic repercussions of a proposed duty on imports of digital watches and components.

Mr. Kvamme spoke on behalf of the Western Electronics Manufacturers Association (WEMA), a trade association of firms that account for most of the high technology semiconductor devices used in digital watches as well as in computers and modern electronic products. National is a Santa Clara, California based company that is one of the largest manufacturers of both semiconductors and of the finished watches.

The bills under consideration by Congress would more than triple the duties on digital watch components assembled for American manufacturers at offshore locations. "Both the conventional watch industry and the new digital timepiece industry sustain US production and employment by shifting certain activities offshore," Mr. Kvamme said.

According to WEMA, the levy on imports of the solid state watch modules used in digital watch manufacture is supported chiefly by US companies that make conventional (non-digital) watches. They favor the tariff increases to protect themselves against stiffening competition from increasingly popular low priced digital watches. Because of lower production costs, many American semiconductor and digital watch manufacturers have located some assembly operations in plants in the Far East. Mr. Kvamme characterized the situation as "a marketing problem between different segments of the US timekeeping industry," rather than a straightforward case of foreign manufacturers flooding the US with cheap products.

If the tariffs were increased, the US companies would probably be forced to close these offshore plants, and the growing availability of inexpensive digital watches would be reversed. Adverse economic effects would be triggered, culminating in the loss of thousands of jobs in the US semiconductor and electronic watch industries.

"In 1976, the US semiconductor industry recorded annual sales of $3.4 billion and employed over 100,000 people. The manufacture of integrated circuits and displays in the US together with the final assembly of digital time-pieces in this country will, and in fact has, provided new employment opportunities for thousands of Americans. If HR 14600 were enacted, however, not only would new job opportunities be lost, but existing jobs would disappear."

Mr. Kvamme pointed out that many of the electronic circuits and numeric displays used in foreign made watches and other electronic products are produced by US firms such as National Semiconductor. One danger of the proposed import duty is that it would probably cause a retaliatory reaction from foreign countries who are now heavy importers of both digital watches and electronic parts from the US. Many foreign governments are trying to encourage the development of their own semiconductor industries.

"US companies, if allowed to compete fairly on the international scene, are expected to increase their market share during the remainder of this decade to 68% of the market, or $7.2 billion."

Mr. Kvamme noted that the low prices of digital watches (about 75% of all solid state watches sold for under $25) allowed the US to capture about three-fourths of the world's market for digital watches in 1976. He predicted that the demand for digital watches would be about two and a half times as great by the end of the decade, resulting in a significant increase in jobs.

The overwhelming supremacy of American electronic circuitry in the world market has resulted in a highly favorable trade balance for the US semiconductor industry. The US posted a trade deficit of $5.9 billion in 1976.

"The semiconductor industry, if allowed to operate with maximum freedom from artificial trade barriers, could change the American watch industry from one that operates with an unfavorable balance of trade to one with a favorable trade balance."

Mr. Kvamme concluded by saying that the proposed tariffs would "hamper a growing and dynamic US industry, will result in higher prices for the US consumer, and will produce retaliation on the part of our foreign trading partners. It will result in the loss of both existing and future US jobs."

National Semiconductor
Santa Clara CA

Breakdown

"Breakdown in communications" is a catch phrase heard about all sectors of life. Is it afflicting hams? As you listen to your favorite band the QRM may immediately convince you that more and more people are talking. Are they enjoying it less and less? Since the breakdown in communications in families, between husbands and wives, among friends and in various other parts of society is mentioned so often, it is no wonder that many hams are feeling unsatisfied with their QSOs. And that other demon, the "generation gap," takes its toll here, too. Old-timers (of whom there are thousands) feel uneasy talking with someone whom they feel knows everything about solid state and computers but really has no love of ham radio because he knows nothing about the old days of homemade equipment, class B modulators, Super Gainer receivers and wire antennas. The younger ham (of whom there are also thousands) feels uncomfortable talking with someone who yearns for the golden days of the '30s.

The ham population is further fragmentized by special interests: TV, phone, CW, RTTY, FM, phone patching, DXing, etc. This is clearly indicated by band subdivisions if one is blind to the poorly concealed contempt that some members of one group often have for members of another group. The barriers are also noted by the various closed repeaters as well as the many nets that occupy the lower bands. The unwary intruder is often told to get out much as a bouncer would throw out a stranger at a Frank Sinatra wedding.

While the modern situation is much more complex, its roots are found in the special interests which were felt from the very beginning of ham radio. There were those who enjoyed rag chewing and it didn't matter much if their Ford-coil spark set only reached the guy on the other side of town. The distance, or DX, mattered very much to others. Their thrills were measured by the mile. Still others felt guilty if they were not of public service, and their pleasure was handling messages free of charge.

Seeing that there have been different aspects with varying appeals from the start, does this mean the FM repeater man, for example, and the lower band DX fan will never have much in common? Not necessarily. But neither does it mean that we are all going to develop an overwhelming interest in one mode of transmission and one amateur band. What is possible, and what our goal should be, is better communications between hams as humans, as people, better communications involving the individual as a person.

Communications is an art, it is said. It basically means expressing yourself and your ideas clearly to another. Sometimes, of course, we do not want to express ourselves too vividly. Guests are invited into the living room, so to speak, but not into the rest of the house. Guests are envious of the new furniture (the new radio equipment) a fellow ham has just bought, but the host doesn't say he still owes ten payments on it or that he and his wife had a terrible family fight because he bought it. But what about the things we *do* want to express?

Enthusiasm is the best vehicle to get them to their target. There is no other ingredient which will so help us get to the heart and mind of our fellow man. It views things through the eyes of a child, and with the heart of a lover. It acts as a self-releasing power and helps focus the entire force of personality on a subject. It lifts your listener into the clouds with you and makes him see the thrills, mystery, romance and fascination which has captured you. It transports your audience from the humdrum into a new world of wonder – your world.

But remember that communication is a two-way road. It is not an attempt to impress another with how great you are or with the expensive equipment you are using. Let's say, for a ham, it's an invitation to another person to share some delights, to have some fun together for a few minutes. Its aim is to encourage two people of similar interests to confide in one another and get to know one another, to build friendship, to create what the Greeks called phileo, fraternal love.

Sincerity comes into the picture, too, then. This helps us to see that the enthusiasm mentioned is not the empty backslapping of a high pressure salesman which perhaps has its parallel in the fancy warm phrases of friendship printed on some QSL cards. If it really was a pleasure to talk with another ham, let us be sincere enough to *write* it on our QSL cards rather than have it printed. Don't the Christmas and birthday cards that you appreciate the most have a hand-written line or two on them? Don't those few phrases truly mean more to the recipient than whether the card cost twenty cents or a dollar?

Stereotyped QSOs have been condemned so many times in so many columns in ham magazines that only a few words are necessary here. What is bad is not necessarily that we say more or less the same thing to each new station with which we talk. What is bad is that we say the same thing everyone else is saying. How boring if the fellow you're talking with at the moment says essentially the same thing the two dozen hams before him said! Let's spice things up with a little originality.

Yes, of course we generally discuss the same things. We all sob over the poor band conditions, mention the equipment we're using and the antenna we have. So, where's the originality? Well, suppose you find out the other fellow is using the same kind of equipment you are. Why not tell him if you've had a problem, what the symptoms were, how you identified the bad component, and so on. This little bit of information is sure to interest him, and he'll tell you if he's had the same problem or a different one and perhaps pass along something that can help you. Or, have you used the equipment in an unusual situation? Is there some feature of the gear you particularly enjoy? Or something that annoys you?

Other ideas? Well, is your shack in an unusual location or an unusual room in the house? Are you using an alternate source of energy to power your rig? Made any modifications to your equipment you're happy about? Helped anyone get his ticket? Offered to give a talk on ham radio to the local grade or high school and had any takers? Any results? Other hobbies in the family? Your occupation?

With the transistorized preamplifiers available, some hams are using antique microphones, and anyone can use an antique telegraph key. If you enjoy such things, let the other fellow know about it. How you got interested, how old the antique is, who used it before – is it all original, etc. If you have a conversation piece in your shack, then talk about it.

Regardless of where you live, mention it by name as well as saying near such and such large city. Many people travel extensively these days. I was talking recently with a Kentucky ham and had to ask three times where he lived. Finally he confessed, "Pikeville." He was amazed that I had visited there several times, and we had quite a talk. Another fellow was in Crossville, Tennessee, but I learned this only by being insistent. Neither of these men could believe that a ham in Peru could be interested in their exact location. On the other hand, I am surprised at how many I talk with who have visited Arequipa. Those who have always tell me about it and ask what part of town I live in, and we usually have a nice visit. Did you know that Arequipa is 450 years old? Has one of the oldest medical universities in this part of the world? Enjoys a climate unsurpassed anywhere?

How old is *your* town? What made people settle there? What are the main industries? Were you born there or did you move there? Would you like to leave? Why? Where do you want to go? Why? Besides the temperature, what else can you say about the weather? Is it raining? Is that good? How is the weather affecting your lawn or garden? What do you see from your window?

What about your family? Do you mention them on the air? A fellow down here in South America was telling me about his equipment one morning when he interrupted himself. He was back in just a moment saying, "That was my wife. I'm always up before her and at my radio. Then when she gets up she fixes me a cup of coffee and brings it to me and gives me a kiss. We've been married 20 years, and she kisses me good morning every day." I felt I had been admitted into the family circle, and that I knew him better. I complimented him on such a loving companion, and we enjoyed a chat about marriage. When we signed off he left me wondering what I'm doing wrong that I don't get a kiss every morning. I'll never forget him.

Some hams on the air for years seem to still have a bit of "mike fright." Perhaps it is because they have concentrated on the technical things of life and are unsure of their grammar and pronunciation. My advice to them is to forget it and enjoy talking. Dizzy Dean was a huge success as a baseball TV play-by-play announcer partly because of the things he did to our language. "He slud into third" was the first expression that caused comment. Later he varied "slud" with "slood" and then one afternoon he came up with, "The trouble with them boys is, they ain't got no spart." When the color man asked at the end of the game for an explanation, Dizzy said, "Spart is pretty much the same as fight or pep or gumption. Like the 'Spart of St. Louis,' that plane that Lindberg flowed to Europe in." If you enjoy something as much as Dizzy Dean loved baseball, your language will not matter much. People will be thrilled to hear you talk about it.

A word of caution for DX contacts. Remember that for most of those operators English is a second language. Speak slowly and distinctly. This is more understandable for them at any time and is more intelligible under poor conditions. Avoid slang and idiomatic expressions and keep it simple.

Your accent shows up on CW as well as phone. I will always remember the Novice I worked on 15. His Morse was about the worst I have ever been able to copy. Of course, he wanted a QSL. I slowly sent him the suggestion that he slow down, that he should try to improve his code and told him I would like to have a couple of IRCs for the airmail QSL. He sent me a hot letter telling me he could send better than he could receive and that he had a certificate for copying W1AW at 20 wpm. He further thought I was a crumb for asking for two IRCs for the QSL. He concluded by stating that the keyer he was using was out of adjustment, and if the code he sent was not readable, it wasn't his fault!

So, if you're on CW, whatever you are using to send with, be sure it is properly adjusted and that you feel comfortable with it. And if you're on phone, turn your mike off before you clear your throat, cough, sneeze or shout at the kids in the other room.

A comment about profanity might be in order. It is against the law, in the first place. And it is a sad commentary on a man's masculinity when he feels that he must show it by his choice (?) of words. But considering that a night doesn't pass without some of these words being heard on TV, perhaps it is too much to suggest that they be eliminated. But if one has to work one or two into every transmission, I personally can not help but feel that he has a limited vocabulary. Sometimes, perhaps, nothing else fits. Anyone who enjoyed the hours long movie "Gone With The Wind" could not help leaving profoundly impressed by Clark Gable's concluding word. Would the FCC, then, overlook every four to six hours one really appropriate "damn"?

Listening is the other half of conversation which, together with talking, makes up communication. If no one listens, it is useless to talk, a point not always realized by those talking. And listening doesn't just mean separating the words from the QRM. It involves understanding or interpreting both the literal meaning of the words as well as the speaker's intention. If someone says to you, "Why you old son of a gun!" the phrase is an insult, but the warmth and affection in the voice indicates exactly the opposite.

Most people, including hams, are not very good listeners. We generally talk more than we listen. And while we're supposed to be listening, most of us are making mental notes preparing something to say just as soon as the other fellow shuts up and gives us the chance. Learning to really listen is not difficult, just rare. Usually considered a passive thing as when listening to some favorite music, listening should be a quite active thing . . . as a real jazz buff carries the melody in his head while listening to the group improvise with various counterpoints, themes and melodies. A stream of words entering our ears must be interpreted not only by our minds as to literal meaning, but by our hearts, too, for the often more important meaning. How close can you come to what the other fellow is really trying to say? Speech is often full of symbols, and the well-trained listener can identify them immediately. The aim of careful listening is to actively seek to discover how the other fellow feels about what he is talking about and what kind of person he is.

And how do you conclude a contact? If you listen, you'll see that many hesitate, stumble, tie the ribbons on, have a final and then a final-final, all giving the feeling they want to sign off but don't want to offend the listener. Have you noticed the same tendency among some of the guests who visit in your home? They get ready to leave, get to the door, and then stand there talking for fifteen minutes. Let's learn something from the "good buddies" on CB. When they say, "I'm gone," they are *gone*. So, let's not rush, let's say what we want to, let's give the other fellow a chance to talk and really listen to him, but when we sign off, let's shut up and not drag it out like a softhearted lover who has decided to break it off but then can't bring himself to say the fatal words and keeps on talking, talking, talking. I'm gone.

George Brumley OA6CV
Arequipa, Peru

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and
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The Best Available
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Mauritius

Pete Smith K4FOK has recently completed a DXpedition to Africa that was intended to put Zambia on the air in a big way. But it was not to be . . . as we learn from Pete himself, via the West Coast DX Bulletin. *– Ed.*

As must be abundantly clear by now, I did not get on from Zambia. My application for a license was turned down with the explanation that the Zambian government does not license foreign amateurs for stays of less than one year. My appeals of this decision, and requests for any sort of temporary permission to operate, went quite high up . . . but were all denied.

Anyway, on to Mauritius where it was a different story. I was issued 3B8DT, largely on the strength of my US license, though, as I understand it, the Mauritian authorities appreciate it if the foreign applicant has some sort of Commonwealth license. I would certainly have a UK reciprocal license in hand if I were doing it again.

I was able to set up at a beautiful hotel on the northwest coast of the island, with a clear shot toward the US. Unfortunately, I did not arrive until late on March 17th, had business all day (the 18th), and finally got back and fired up the equipment for the first time after midnight (local time) — about 2000Z on March 18th.

The first twelve hours of the ARRL DX Test were an utter disaster with something like seven contacts, but things picked up after that. Good conditions on 15, fair on 20, and 40/80 mostly not so hot as much of the time I was in daylight and the QRN was over S9. I think I shook a few people in the waning hours of the contest answering their CQs on forty.

The total reads 583 US contest QSOs without duplicates. There were about 15 with the West Coast and about 500 with non-US stations, these during periods when the bands were not open to the states. All but thirty of the QSOs were CW. Unhappily, I had to pack the gear and head for home on March 21st, and I did not get the chance for the phone operation I would have liked to have had.

Although I was unable to get on from 7Q7 Malawi, and had understood that all operation there had been suspended back in June 1975, while listening one evening on twenty I heard 7Q7LW working through a pile of JAs. She gave a box number in Zomba as address, and there was no reason to think that she was not genuine.

Thanks to the Northern California DX Foundation for equipment and other assistance, including QSLing. The DX Foundation tells me that they intend to QSL every contact through bureaus as soon as the QSL cards are ready.

Pete Smith K4FOK/3B8DT
Reston VA

Pitch

In light of recent efforts by Jack Anderson to discredit ham radio, many amateurs replied with the other point of view in letters and telegrams to their congressmen and hometown newspapers. Some, like Larry Schwartz WB3DBI, took another route — in this case a high school newspaper. — Ed.

Last year, over 6,000,000 new CBers received their licenses, bringing their total number to over 8,000,000. But throughout the US there exists another group of radio operators.

In contrast, they form a much smaller group, about 300,000. Whereas CBers run four Watts of power, these people legally run as much as 2000.

CBers operate on 40 channels while the other operators have literally thousands. While most CB equipment costs between $100 and $300, the other group can pay this price or invest thousands of dollars in a station. The Federal Communications Commission (FCC) also permits this other group to construct their own equipment if they so desire.

Who are these other people? They form a group of radio operators commonly known as "hams." Hams communicate all over the world using Morse code, voice, and Teletype. The FCC even allows hams to use television to communicate. Additionally, where facilities permit, hams can use their radios to place local phone calls while remaining in their cars.

With all of these privileges, why doesn't everyone become a ham? Mr. Donald Smith, an electronics teacher and a ham radio operator, explained, "Ham radio shows technical knowledge and not everybody has the desire to go into it."

To qualify as a ham, one must first pass a Morse code test and then pass a test dealing with electronics and radio law. Passing tests of greater difficulty qualifies the applicant to operate at more frequencies. Put another way, they receive a larger portion of the radio spectrum.

Junior Ari Hirschman, a ham radio operator, told why he got started: "I liked the feeling that I would be able to talk over such long distances and sometimes be able to do it with equipment I built myself. I also like the technical aspects involved."

Sophomore Paul Schmidt, also a ham, gained an interest in ham from his brother. "When I first became interested, I hardly knew anything about radio and it sounded like a neat idea."

Paul said that recently on the air he met somebody who challenged him to chess. The whole game was conducted over the radio.

Hams also perform many public services. During the Guatemala earthquake in 1976, hams went into action. Hams flew to Guatemala and, using their equipment, sent reports back to the US about the situation there. Many times during a parade hams will monitor the parade route and keep in touch with the police.

Hams also form many on-the-air groups. These groups may handle and relay messages, such as those during a disaster. The groups may also discuss electronics or play games. Many hams even do their homework over the air.

Recently, courses for people interested in studying for their ham licenses have grown. The Montgomery (MD) County Department of Recreation offers courses providing the electronic theory needed to pass a ham test. Interested persons should phone 468-4050.

Larry Schwartz WB3DBI
Bethesda MD

Reprinted from Pitch, *published by Walter Johnson High School, Bethesda MD.*

Respect

Your personal help is requested in achieving more harmony in our overcrowded 20 meter phone band. Working DX is the major interest of many worldwide amateurs — SSTV, net operation (handling important and vital traffic), and, then too, just plain rag chewing enjoyed by many, many hams.

Let's examine the space allocated for SSB on 20 meters — 14,200 to 14,350 kHz. Yes, only 150 kHz! It is a well-known fact that most DX is worked at the low end of the band, 14,200 kHz and up. Let's arbitrarily suggest 10% of the 150 kHz for DX. This would give the DXers 14,200 to 14,215 kHz. The 14,230 kHz + or - 3 or 4 kHz is the SSTV area. How about 10% for nets and traffic? This group is pretty well established in the area 14,300 to 14,315 kHz.

Irate SSTV, DX, net and rag chewers continually harass SSTV, DX, net and rag chewers with carriers, tapes, CQs and other noises. Effective, yes, but definitely not the answer to the problem. The resulting QRM renders the frequency useless to all, and everyone loses. Tempers flare, anger, irritation and frustration prevail. Our hobby is degraded. This could all be avoided if amateurs used better judgment in selecting the proper frequencies for SSTV, DX, nets and rag chewing.

You will note that I said above "arbitrarily" when I suggested the frequencies for the various groups. You could never reach a definite agreement among all the hams on 20 meter phone, but this could be a start!

Henry Luhrman W4PZV
W Palm Beach FL

Reprinted from The Mike and Key, *bulletin of the Greater Cincinnati ARA, Cincinnati OH.*

Eye Bank

In the United States, eye banks are served by a network of volunteer ham radio operators. Three hundred and sixty-five days every year without a holiday, this rapid nationwide network stands ready to flash the news of emergency requests for eyes, and where eyes are available.

In emergencies, from fire, a laboratory explosion, an auto accident, certain acute infections, where immediate corneal transplants are necessary, the Eye Bank Emergency Radio Network serves as a means of saving the eyesight of hundreds of people. It assures that a donor's eyes will be rushed anywhere that an emergency exists.

The Eye Emergency Net, a true public service net, has been in continuous operation for almost fourteen years through the untiring efforts of a distinguished and highly dedicated group of amateur radio operators.

Briefly stated, the purpose of the Eye Emergency Net is to handle information regarding the need for and the availability of human eyes for emergency corneal surgery for the various eye banks throughout the country. In accordance with this simple purpose of trying to be of assistance in preventing the loss of sight in an emergency situation, it has been decided that henceforth only emergency needs for eyes and the availability of eyes will be listed and carried on the several Eye Emergency Nets by the net control operators.

Each amateur radio operator is requested to so inform the eye bank he or she represents of this policy of listing only emergency needs and/or the availability of eyes. This will improve the efficiency of the Eye Emergency Nets and will eliminate needless repetition of unnecessary and useless information as has crept into the operation in the past. Naturally, each amateur radio operator should keep in close contact with his or her eye bank to keep them informed of emergencies listed and/or availabilities. In this manner we can carry out our avowed purpose of helping to save sight in emergencies and, in addition, operate more efficiently with less time occupying crowded radio frequencies.

The policy stated on this page is to aquaint my fellow amateurs with the Eye Emergency Net. I am a net member representing the Midsouth Eye Bank of Memphis, Tennessee. There are several nets which meet every day of the week, every week of the year. The only exception is the first one, which doesn't meet on the weekend. (All times are EDST.) 0600-3970 kHz; 0645-3970 kHz; 0800-7294 kHz; 1845-7294 kHz; and at 1900-3970 kHz. I check into the net that meets at 0645 on 3970 kHz. I have found that I can meet this net and be on the road to work by 0700. It only lasts about five or ten minutes. I also call the eye bank and leave a message with the answering service as to the need or the availability of donor eyes. All this and I am still on the road to work by 0700 and usually earlier than that. As you can see, the net is quick and to the point, and serves a great need to the Eye Banks of America. Can you find five or ten minutes in your busy schedule to help a person to gain back his eyesight? If not, close your eyes and walk to the refrigerator, pour yourself a glass of milk, then turn on the TV, sit back and relax.

Guy Speck WA4WHQ
Memphis TN

Reprinted from Telstar, *bulletin of the Memphis Pioneer ARC.*

The New

1977
REPEATER
ATLAS

of the World

see page 200

Light

A recent editorial in the March, 1977, issue of *Ham Radio* magazine caused me so much pain that I feel compelled to take pen in hand and do something about it. The author has a good topic (the 40th anniversary of the invention of the klystron) and he traces its development in a well-informed manner. His summary and call to action, however, fall far short of what could be a noble point. The editorial writer calls for more activity on the microwave frequencies to protect our allocations in light of WARC '79. This conclusion is less than worthy for three reasons. First, nobody in positions of importance would know, nor would they care, if amateur activity on 10 GHz increased ten times over. Secondly, the contribution the amateur service could make to the microwave state of the art is nil. Finally, the people who might spend their time working on amateur microwave could make a very important name for amateur radio. They could make a name that would be heard and recognized where it matters.

The microwave frequencies are familiar and well-known territory to military and commercial communicators. The frequency congestion in some parts of the country makes the California two meter repeater problem look like the wide open spaces. Millions of people daily talk over long and short distances on 15 GHz and up without causing any excitement. Digitized transmission systems are becoming the rule and are replacing the old analog modulated networks. It is not in the best interest of a vibrant and progressive amateur radio service to try to duplicate the plumbing and hardware developed so well so long ago. The fourteenth inventor of the wheel probably got very little notice. There is nothing much for us in the microwave frequencies. There is not much utility, no new ground to be plowed, no records to be set, nothing but a lost wandering in a wasteland full of funny machine shop products.

Now that I have alienated everybody who even knows what a klystron is, here is where I propose we put our efforts. We must skip around everything that is too high for coax and keep going. Go up to the new communications ground where the future is full of real frontiers. Go up to where new developments and uses are waiting to bring riches to individuals and pride to amateur radio. Go up to light!

The use of light for communications is just passing out of its infancy. Its first real steps were recently taken when the Bell System began using a light pipe to connect switching facilities in Chicago. Amateur use of light for communications can follow two very important parallel paths.

When amateurs think of using light for communications, they naturally think about transmission systems. This means shooting a light beam to some other guy and modulating it in some way. It does not necessarily mean relatively expensive lasers and high voltage power supplies. Light can be reflected, for instance. Sunlight for reflection is plentiful and free. The same hams who can design a moonbounce array can certainly figure out a cheap and easy way of modulating a reflected beam. Clouds might be a problem, but we have lived with the ionosphere all of these years, so what are a few clouds?

Light as a transmission system is certainly line of sight (unless you bounce it, that is). There are probably more and better ways to bounce a light beam than a microwave beam. They just need to be developed. Instead of a repeater on a mountaintop, how about a mirror? Want to talk to somebody? Just kerchunk the mirror. Not as good as two meters for mobile, probably, but a whole lot better than 10 GHz. On field day you could rent one of those searchlights they use at shopping center openings! Moonbounce is still a good bet, too. During the day your moonbounce reflector could probably provide hot water for your house. (Please don't write to me and tell me you can't reflect light off the moon. I'll have a whole generation of song writers ready to pounce on you.)

Along with light as a transmission system, there is another path that amateurs can explore which will be far in advance of available commercial systems. Light can be filtered, chopped, amplified, heterodyned, attenuated, modulated, and detected (and just about anything else that can be done to rf). It is not, however, inherently leaky. When contained in a glass or plastic light pipe, it is immune to electromagnetic hum, crosstalk, rf feedback, etc. Light pipes can be driven by our everyday friend, the LED. Light can be used, then, at lower level stages instead of af or rf to generate and process signals that can use rf, af, or light as a transmission system at higher stages. What I'm suggesting is that your Sooper Blinker 20 meter SSB rig of 1982 might very well use light starting right at the microphone to generate and process the audio that would eventually modulate the 14 MHz rf stage. Why? Because sand (glass) is cheaper than copper ore. Light needs less shielding and is less troubled by ground loops, etc. All sorts of neat processing can be done with the spectrum available.

This means that amateurs who don't want to use light as a transmission system can still experiment with and develop very important techniques in their own shacks. This activity is very much in keeping with the historic experimental tradition of amateur radio. The size and cost are low, and the potential is enormous.

I call on the gadget lovers and tinkerers in amateur radio to get with it. Quit trying to interface your SSTV to your microprocessor, let microwaves cook baked potatoes, and move up to light. *73 Magazine* has led the way in slow scan, 2 meter FM, and microcomputers. It is now time to start sending in articles on the newest and grandest development yet. Do you see the light?

Capt. Frank J. Derfler K9KIC
APO San Francisco

HRO

In 1978, hams all over the world will witness an event that will bring them undreamed-of fame — The Ham Radio Olympics. The HRO will accomplish what years of public relations could not, making ham radio a respected household word throughout the world, in Africa as well as in California.

Since 1979 will be the decisive year for ham radio, in the World Administrative Radio Conference (WARC) which will meet to decide what frequencies ham will use, the HRO will come at just the right time. The good press the HRO will obtain, and the national prestige it will engender, will carry over into the WARC and we will see countries competing with each other to get the best deal for ham radio.

Later this year, the International Amateur Radio Union will proclaim 1978 the year of the HRO and will notify all the governments which it represents. A committee will meet in Geneva to make simple preparations. What the committee will have to work out is what kind of events will not favor large countries and power amplifiers. There will be events of skill, perhaps tests of code reception and transmission, total number of contacts, longest distance per Watt on each band, or the ability to work through a satellite.

After the week or so of competition, the committee will convene, report on what they heard, and vote. They will present awards to the winning hams and their countries.

It will take a lot of work and much organizing, but we can do it. 1978 will be a year for all hams to remember, the year of the Ham Radio Olympics, the year ham radio became the "in" thing, the year governments started favoring ham radio, the year before the WARC when hams came out with far more than even the ARRL dreamed of asking for.

Gabriel Gargiulo WA1GFJ
East Hartford CT

Ham Help

A few years ago I ran across a construction project in the library of a fellow ham. Now we cannot locate the project, but if my memory serves me correctly, I think it may have been in one of your publications. I would appreciate your help in locating it.

The project was a solid state device to track thunderstorms. This is the solid state version of an original article, "An Electronic Storm Finder," which first appeared in "The Amateur Scientist" column in *Scientific American*, May, 1963, p. 167.

Jared A. Ketner WA0QWU
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Wahoo NE 68066

I require a schematic diagram and alignment procedures for a Hallicrafters "Skyrider 23" receiver. The manufacturer says it's out of print. Many thanks.

J. Sutherland
P.O. Box 210
Hampton, N.B.
Canada E0G 1Z0

I am writing to try and find something about a new animal we are all beginning to know if not love: interfacing. I wish to develop a teletype system for my shack that is as noise-free as possible. I live in military quarters here in Germany and complaints about RFI are bad enough without having the neighbors complaining about the noise of TTY machines. I am also trying to keep the cost of the whole thing within a military salary type budget. This obviously knocks out HAL products.

I would like to develop the system around an AFSK type demod. This will prevent extensive modifications to the radio equipment. Now comes the interfacing problem. I have been faithfully reading all the I/O articles and the ham TTY articles, and hopefully have developed a vague reading knowledge of the medium. I have also seen that most of the different systems would be totally incompatible with each other. ASCII-to-Baudot/Baudot-to-ASCII converters look great to tie a computer to a TTY machine, but will they tie an ASCII encoded keyboard to a TTY demod? Will they tie the demod to an ASCII video character display?

What I would really like to know: Have you any suggestions for kits that would be compatible and not overly expensive? I'm not trying to force a manufacturer's recommendation from you. I realize that you have to maintain a fair outlook towards them all. I'm merely trying to keep from a lot of experimentation with some rather expensive devices that might not like one another at all. My working knowledge of digital circuitry is limited to the speed keyer and digital counter level. I haven't dived into LAI circuitry at all as of yet. I do see a computer in the future, but it is a financially far future.

If I haven't completely confused you by now, I hope you have something which will point me in the right direction. I will be QRV for any suggestions to keep the old TT-15 from keeping the neighbors awake.

Sgt. Anton M. Giroux
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I am an ardent home brewer and lover of CW. Since reading about the attributes of the FYO key, I have become interested in attempting to build or buy one. Could you or any of the readers of *73* assist me in this effort, such as pictures of an FYO or perhaps a source of the key itself? Thank you.

Bob Best WB1AQM
Pine Tree Rd., RR #2
Coventry RI 02816

I would like to get in touch with other hams who read science fiction literature . . . such as Clarke, Asimov, Heinlein, etc.

Neil Preston WB0DQW
7024 Bales
Kansas City MO 64132

WANTED: Hams near Chicago to form a DX and Contest Club – Novices to Extras wanted. Please contact me for information.

Randy Terborg WB9SAD
10137 Kostner
Oak Lawn IL 60453

WANTED: A manual and/or schematic for an Ameco 2 and 6 meter transmitter, model TX-62. I could either purchase the manual or make a copy of it, then return it to the owner. Any help would be appreciated.

Charles Dedon WA5WZI
Rt. 1A, Box 500
Walker LA 70785

Even though I am not (and cannot become) an amateur, due to disability in my hands, I do read your magazine. I teach electronics free to any young person who is really interested, enough to give up an hour or two a day. We use mostly surplus material to build projects, and have great difficulty in getting data on much of it.

Can anyone provide addresses or sources where we might obtain data on integrated circuits, nixie tubes, or related components? For instance, we have a 12 tube readout, alphanumeric, which we would like to use, but can find no information on.

The tubes are 13 pin (5 in front, 6 in back, a blue sleeved lead on each side). Monogram on back: ISE-DG12C-HB:D. ICs: DP4, DN2, HD3107DM, M5B201, M5B205, M5B207, and one M5B212, with associated transistors, diodes, and resistors, which we do have data on.

On the board are these numbers: HEC 011 EPA, 504-PCB-B, and 13925-H. Please send any information.

Edwin O. Griffith
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RTTY Loop

This month we are going to discover just how Teletype is sent. For the purposes of this discussion, forget all you know about radio. During the next few minutes, the only way to get information from point A to point B is by stringing wires. You'll see why later. Now let's look into non-voice communication systems.

I am here, and you are there, and I want you to get me a hamburger. So I string a wire from me to you and connect a switch, battery, and bell. See Fig. 1. We agree that one ring means "hamburger," two means "7-Up," and three is for "french fries." What do we do for chicken soup? Clearly this system is limited, and some encoding form is needed. Obviously, that is what alphabetic codes, such as Samuel F. B. Morse's, do. But this type of system did not lend itself to automated systems in the PICE (pre-integrated circuit era). We need a way to send each letter and figure from me to you and have a machine interpret it.

Refer to Fig. 2. Twenty-six buttons, plus any figures or punctuation, are at my station. Each of these buttons (arrange them in a keyboard if it will make you happy) is connected to a long wire which spans the gap 'twixt you and me. At your end, each wire feeds an electromagnet with some linkages resembling an electric typewriter. I hit the "Q", the "Q" wire is energized, your "Q" magnet pulls in, and a "Q" is typed. Add some means of returning the carriage (CAR RET) and feeding paper (LINE FEED) and you have a workable system. (These two are also abbreviated CR and LF.)

But wait a minute. You have to string more than 30 wires who knows how far just to do this. If you will pardon a bit of borrowed terminology from the computer folks, this is a "parallel" system. That is, all wires (bits) are there (read) at the same time. All we have to do is convert this to a serial system and send each bit sequentially, and then we can go back to one wire between stations.

Take a glance at Fig. 3. Now we have added a motor-driven selector switch to each station. Now when you push a button, two things happen: The clutch engages and a "START" pulse is sent, and the appropriate letter pulse is sent at the correct time. At the other end, the "START" pulse engages the clutch, and, since the motors are turning at *exactly* the same speed, when the pulse for the letter sent arrives, the receiving selector switch will be at the appropriate

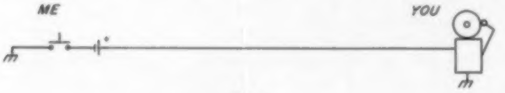

Fig. 1.

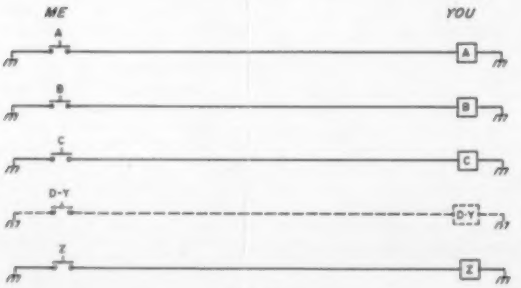

Fig. 2.

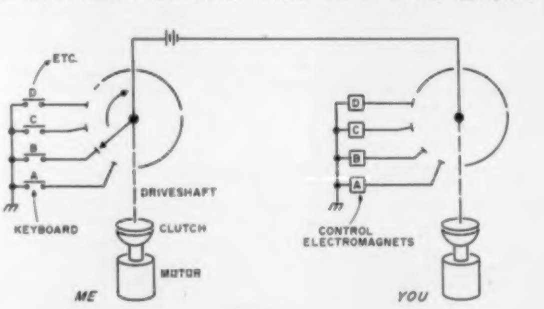

Fig. 3.

terminal to activate the corresponding magnet. Neat, huh?

Only one problem. Just to send the letters of the alphabet, you need 26 pulses plus the START and STOP pulses. Twenty-eight bits! At, let's say, 25 ms per bit, a reasonable speed, it would take almost ¾ of a second to send each letter. That works out to around fifteen words per minute. There has got to be a better way. There is . . .

Take five bits and encode them in a binary progression. This gives 2^5 or 32 possible characters. To get more, without using more bits, use both upper and lower case. Fig. 4 shows one possible scheme. Now, reduce the switching of Fig. 3 to send just five bits plus a start and stop, and you can send whatever you want, with 22 ms pulses, at 60 words per minute. Make the pulses shorter and you can send faster, and this really works!

BINARY	LC	UC	BINARY	LC	UC	BINARY	LC	UC	BINARY	LC	UC
00000*	BL	BL	01000*	LF	LF	10000	E	3	11000	A	–
00001	T	5	01001	L	)	10001	Z	"	11001	W	2
00010*	CR	CR	01010	R	4	10010	D	$	11010*	J	'
00011	O	9	01011	G	&	10011	B	?	11011*	FG	FG
00100*	SP	SP	01100	I	8	10100*	S	BE	11100	U	7
00101*	H		01101	P	0	10101	Y	6	11101	Q	1
00110	N	,	01110	C	:	10110	F	!	11110	K	(
00111	M	.	01111	V	;	10111	X	/	11111*	LT	LT

**Notes on individual codes:*

00000 – BLANK, cycles machine in open condition. Will shut down machine in some loops.

00010 – CARRIAGE RETURN, usually abbreviated CR or CAR RET, returns type basket to left hand margin.

00100 – SPACE, advances typing basket one space without printing.

00101 – H, in upper case may be £ (pounds sterling) or STOP. This, used as stop key in some circuits, has no radio use.

01000 – LINE FEED, usually abbreviated LF, advances one line of paper.

10100 – S, upper case usually BELL, which rings a loud bell in the machine. Some machines type ' instead, and use upper case J for BELL.

11010 – J, upper case ' (apostrophe). See note for 10100, above.

11011 – FIGURES, usually abbreviated FIGS, puts machine in upper case.

11111 – LETTERS, usually abbreviated LTRS, puts machine in lower case.

Fig. 4. Binary Teletype Code.

To make it practical, when you push a key on the keyboard, mechanical linkages set up the appropriate five-bit code, which is then scanned by the motor-driven switch and sent down the line. A selector magnet driven off that line pulls levers in as a toothed wheel allows brief samples of each pulse interval. The received letter is sequentially encoded and, at the conclusion, read out in parallel form. Levers and trip hammers are set, and the proper key is struck on the platen. For the computer buffs out there, note that the characters are first generated in *parallel*, converted to *serial* for transmission, then received *serially*, and reconverted to *parallel*.

A common problem for RTTY operators involves the mechanical speed of Teletype equipment on each end of the "loop." Again referring to Fig. 3, it can be seen that the receiving machine must be in the "start" position when the transmitter sends a start pulse. Imagine for a moment what would happen if the two machines were not synchronized to each other! Most likely, an invalid "garbage" character would be printed, which is exactly what happens when RTTY is transmitted over a noisy path. Some method of insuring machine synchronization is required, and fortunately the problem is easy to solve. The power company maintains close watch over the frequency of our line current, and, while voltage may vary considerably, the frequency is always very close to 60 Hz. This fact is employed to our advantage in most TTY machines. The motors that drive the mechanical linkages in the machines are usually "synchronous" motors; that is, their speed is a function of power supply frequency, not voltage. Most synchronous motors will maintain speed over a wide voltage range, although their torque suffers at voltages much below 100. Thus, when the TTY machines at both ends of a path are driven by synchronous motors from the power line, they are automatically "in step" with each other. True, there are adjustments on all machines that can cause misprinting. These will be discussed at a later time. The moral of the story is to be sure that any surplus machine you purchase has a synchronous motor. This fact can be verified by checking the information plate on the motor. It should say "synchronous." Avoid machines with "shunt" or "series" motors. Usually they are not worth the effort, no matter how attractive the price. These machines are synchronized by mechanical governors and springs that are never accurate over the long term. Many military machines fall into this category, as they were designed for field ac/dc usage. Pass them up if anything else is available! Future columns will describe the equipment available for beginning RTTY applications.

Hopefully you are now aware of the "mechanics" of Teletype transmission and reception. The next step is to eliminate the wires between the transmitting and receiving stations. After all, the "R" in RTTY stands for radio. Next month's column will outline the encoding and transmission of TTY pulses over radio.

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Looking *West*

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LINKING AMERICA

Just another normal Sunday evening on .01/.61 in Los Angeles. Let's see. There was myself, Mary WA6LUC, "Uncle" Earl WB6MUQ, Doug K4SWJ and Bill WB2RXQ, to name but a few. Why should this be of note? Well, you see, Doug and the rest of the "4 landers" were in Atlanta, and Bill RXQ and the rest of the "W2" stations were in Staten Island, New York (and we must not forget that fine group of "1's" on the WR1ABB system near Boston). Not exactly what one thinks of as your average "run of the mill" evening QSO on a local two meter system. In reality, though, it's not your average two meter anything.

What it was and continues to be is a project in repeater interlinking spearheaded by Sam Davis WA1GQY/WB6GDM. Not long ago, Sam placed into operation what he calls his "magic talking box," better known as the WR6AYY 220 repeater/remote system. He got the idea that there was more that could be done with it than just talk locally. Heck, why not link it to another machine in another part of the country and let the people in both places rap with one another for a while? Since Doug had been a popular resident member of the L.A. repeater fraternity when he lived out here, the first choice was evident: a link to Atlanta. However, we thought that using AYY (a private 220 system with a dozen or so members) might not be as much fun as having access to this link from a major high traffic open machine. Since AYY was a remote base as well as a repeater, it would be easy to tie it to virtually any two meter system. That's how WR6AUD (WR6ABB) got involved.

At about 7:00 pm on Sunday, May 2, 1977, a group of W4's suddenly appeared on 146.61 in L.A. They could easily be talked to by transmitting on 146.01. Involved in the linkup were the aforementioned WR6AYY, WR6AUD and WR1ABB, as well as WR4AAE (Atlanta) and WR2ADP (New York). I only wish there were room to list everyone who took part, but space restrictions force me to limit kudos to Bill Helfand WA6JEU of PARC (for his technological wizardry), Mary Stocksdale WA6LUC (who spent about four hours as "emcee" here in Los Angeles, keeping the whole show moving along), and Sam Davis WA1GQY. Sam's "let's do it" attitude had the effect of uniting an entire continent via amateur FM relay com-

The WR6AYY "Magic Talking Box," with its creator, Sam Davis WA1GQY/WB6GDM. Photo by Norm Smith WB6DGF.

Linking America's "control central," at the home of Sam Davis WA1GQY/WB6GDM. Photo by Norm Smith WB6DGF.

munication, with a slight help and a large phone bill from Ma Bell. When I asked Sam why he did it, he simply answered, "It was fun."

If you happen to have such a system, that "wants to get involved" and also happens to have autopatch facilities, you might drop a line to Linking America, c/o Sam Davis WA1GQY/WB6GDM, PO Box 1502, Sun Valley CA 91352. Who knows? If you do, one of these Sunday evenings we might get a chance to QSO as well.

REPEATER APPRECIATION WEEK

After the storm: Contrary to what you may have read elsewhere, the event previously described in this column in detail has had a profound and lasting effect on overall repeater operation in this area. Now that enough time has passed to really evaluate it, I have to reach the conclusion that the prime reason for its overwhelming success is that none of us, myself included, ever wants to have to live through another such repeaterless time.

In the basin, the day of the repeater hog and abuser is waning. It is giving way slowly but steadily to the day of the good guy, the average "Joe Ham" who was for a long while the target of the abusive minority that had almost made "repeater life" untenable. Repeater Appreciation Week changed all this, however. It made old "Joe" aware of the fact that if the privilege granted him by his peers was to continue, then he would have to take on the most important burdens of all — setting the best possible example for the rest of the amateur community, and being his own "repeater cop" when necessary.

To cite one example, six months ago it was quite common to hear a bunch of people rattling off about some unknown poor "flake" who had gotten his jollies by jamming or harassing a given system. Nowadays, about the only time you hear such a complaint is at off-the-air meetings. Not that all the on-the-air jammer recognition has abated, but the unofficial word seems to have proliferated enough that most people know these days that if you want to really frustrate a jammer, foul mouth or sickie, the best way to accomplish this is to totally ignore his existence. I'm willing to bet that there is more complaining going on on the telephone on this topic these days than on the air.

In the years I have been writing Looking West, no topic has brought the mail load that this one has. In fact, some has come from as far away as Germany, which at least lets me know that this column gets read. In general, responses from densely populated areas were positive on the action taken by the "Ad Hoc Committee for Open Repeater Appreciation," while those from less populous parts of the country went as far as to say (in certain instances) that the overall deterioration level we had described could not possibly have existed. Some said that no matter how bad things had become, no one had the "right" to take away the repeaters. A few went so far as to say that, whether supported or not, the repeaters belonged to the people who used them. Therefore, they reasoned, the licensees should be prepared to take anything that comes. Most, however, cited the whole affair as being not only a shame to have happen in the first place, but also a "blot" on the overall face of the amateur service. Having personally lived through the period of decay, the action itself, and the subsequent revitalization now going on, I could not agree more with this last view.

Another interesting point is that, with few exceptions, those responding negatively gave little or nothing in the way of counterproposals that could have been attempted before any such drastic action was taken. Most negative comments were just that — negative on the basis of "right to operate," or to the effect that "something else" should have been done. Never could we figure out what this elusive "something else" was, however. Many letters claimed that I had not been objective enough in my reporting on this topic and had given too much column space to the "positive results" (while downplaying the negative aspects). To this I can only say that we judged by what we heard on the air, and never once did a confirmed, "self-professed" bad guy, "repeater hog," or "jammer" call us on the phone to complain.

I had hoped to be able to reproduce a few of the comments and responses received. However, due to space limitations and the desire to avoid repetition of things already discussed, I think it best to put this one to rest with the following summary. For us, the concept of "Repeater Appreciation Week" did work. It did have what has turned out to be a long-lasting positive effect. It did lead to "cleaner" overall area operation in general, although we are still far from being the "world's showplace." If we ever were able to achieve the status of "showplace," I suspect that it would probably make for a rather lifeless, sterile, and uninteresting format of operation. While such might be welcomed by some, to the vast majority of local amateurs a totally sterile atmosphere would in itself create another form of decay: attrition of both amateur relay communication and the numbers in our ranks. We can afford to lose the bad guys, the troublemakers, foul mouths and the like, but losing the good people, those who appreciate what others have done for them and show that appreciation through due respect for their fellow men, we cannot tolerate.

In essence, we are again climbing the ladder. We are looking for a happy medium some place in between, a place that fits and suits the lifestyle that is Southern California. This time we are aware of the pitfalls that mistakes lead to. I suspect that this awareness is the insight we need to reach the "happy medium" we are striving to attain. If we fall along the way, we will only have ourselves to blame.

To those who have asked if I recommend action such as this to others, I respond by placing the responsibility for finding this answer back on their shoulders. Because it worked for us does not mean that it is the ultimate answer to all the problems plaguing open repeaters everywhere. You alone can judge the degree of the problems in your area. You alone can determine if all other avenues have been attempted to correct these problems and if taking drastic action, such as holding a "Repeater Appreciation Week" in your area, will solve anything. It is not a solution in itself but only another tool in attaining a one. I sincerely hope that you never find yourselves having to implement such drastic action as was seen here in January. Be wary; the fact that it helped us does not guarantee that it will work for you. Use your own individual and collective judgments.

THE WAY UP NORTH: THE CENTRAL VALLEY IS ALIVE, WELL AND ON TWO METERS

Another subject that has brought a heck of a lot of mail, mostly from the Central Valley area of California, was part one of my November '76 trip to Northern California and the San Francisco area. It seems that I may have hurt a lot of people's feelings in the Central Valley by not mentioning the activity I found there. To those I may have offended, I apologize; to those that were kind enough to write me with updated activity information, I say thank you; to those who spent many paragraphs berating my ownership and use of a CB radio, I have nothing to say whatsoever. Correction: To the latter group I suggest that energies could be better spent in more constructive ways than tirades against CB. Sure, it has its problems, and true, it's not "ham radio" type communications, and yes, there can indeed be a language barrier. I have come to the conclusion that in a crowded urban area such as L.A., the lower 23 are usually so crowded as to be useless, with the possible exception of channel 9. However, once out of a city like L.A. (with its massive numbers of spectrum users) and "on the road," you won't find me making any long trip without one. Enough on this, though: Let's get into the activity we found heading north on I-5, and fill in the material supplied on what we missed heading south on 101.

After running out of the range of the Los Angeles area systems our Denshi radio was crystalled for, our first interesting encounter came on that popular channel pair of .28/.88. Thanks to Ken WA6TCP, we were provided with the following information about WR6AIF (and a rather enjoyable 25 minute QSO, as well). WR6AIF is a wide coverage open system located atop a 5700' "bump" known as Blue Ridge, which, for those of you trying to pinpoint these things on a topographic map, is about 22 miles east of the city of Visalia. The system runs about 40 Watts erp, is open carrier squelch access, and is owned and sponsored by the Tulare County Amateur Radio Club, Inc. One of the nicest things about it was the totally relaxed atmosphere we found.

The timeout timer is approximately two minutes and forty-five seconds, so it is quite easy to compose your thoughts as you proceed with a QSO. Ken says that while it's usually a fairly quiet daytime operation, weekends, holidays and evenings the system really comes alive and a QSO is not hard to come by. In our case, we were weekday travelers, but found no problem finding a friendly hello on WR6AIF. If you are in the area and see a sign marked Exeter or Visalia, you might give a call on .28/.88. I suspect that the ensuing QSO will be one you will enjoy.

A little farther up I-5, just past junction 44, we found ourselves in QSO with Dick W6OV via the WR6ACU repeater located at about the 4000' level at Meadow Lakes. ACU is, according to the latest NARC listings, one of three open .34/.94 repeaters in their jurisdictional coordination area (along with three others which are tone access). Meadow Lakes is located just northeast of Fresno, and is the kind of vantage point that gives ACU good coverage over most of the Central Valley, from an area just north of Bakersfield to the intersection of Route 580. That, friends, is what we call coverage. While I did not have .31/.91 in my radio, Dick informed us that WR6ACE (located atop McKittrick) had similar wide coverage characteristics. Again, the kind of welcome we found on ACU was outstanding, and causes me to wonder a bit about stories we hear from time to time about a traveler in a given area "getting run off a repeater" because he did not belong to the "in crowd." We were strangers on a heck of a lot of systems on our trip, and never once were we made to feel unwelcome anywhere. If these things do happen, it's surely not in the Central Valley or San Francisco area.

Once north of ACU's area of service, we began the normal ritual of running through our 10 repeater pairs. As we came to .01/.61, we found ourselves eavesdropping on a rather interesting QSO on the WR6AFA repeater. I like a good technical discussion, so after a few minutes we made our presence known. We soon found ourselves in QSO with AFA's owner, Steve WA6SBM. We never did ask Steve where AFA was located. However, we accessed it about the time we ran out of ACU, and were with it for about an hour (until Steve informed us that we might be at a point where we could gain acquisition of WR6ACV near Stockton).

It turns out that Steve is one of the "new pioneers" of VHF up there. He already has in the works a 220 system (that will be on the "low .34/.94" pair), a UHF system, and a six meter system (that he plans to link to another six meter system running in the Marin area). He plans a few autopatches in this web of rf as well. Steve was a veritable gold mine of information, and since our QSO took place about five months ago, a lot of what he described to me as being a part of the future may have already come to pass. A word of thanks to Ray WB6GUK, who sort of got placed on the sidelines as Steve and I rambled on. One of these days I've got to make this trip again, if for no other reason than to see how much of Steve's major undertaking has been accomplished to date. I found myself that fascinated.

I wanted to get hold of my buddy Dave WB6IRL who lives in the Stockton area. That part of the world is serviced quite well from the .28/.88 WR6ACV repeater atop Mt. Oso. Dave and I first met at a training session here in L.A. being given by the company we both worked for at that time. At any rate, after finding that we could work into Mt. Oso, we gave Dave a call and were surprised to get a response from his XYL (who we did not know had obtained her ticket). We were informed that Dave was out at the moment, and that as soon as he returned he would be summoned to the magic talking radio. A while later, just as we were leaving ACV's service area, we did manage a few minutes with Dave (which were continued the following evening via landline).

I-5 sort of skirts the prime coverage area of WR6ACV. However, with nominal power and a good receiver it is possible to work this system over a good number of miles. In most places, our 12 Watts and 5/8 wave GAM were more than sufficient. ACV is a system-designed repeater, in that it is one where if you can hear it, you can work it. Conversely, if the road takes a dip and you go away for a few minutes, you won't hear it either. In practice, this is considered proper overall system design, and is exactly what those involved in commercial land mobile service strive to attain. We finally lost ACV altogether as we started the "big climb up the hill" that leads down into the "City by the Bay." In the interim, however, we had a chance to chat with Dave, Joyce, and a large number of other super people who make WR6ACV their home.

Since we have already covered much of the activity we found in the Bay area in a previous column, let's say a quick farewell to the Golden Gate and start south via Highway 101. Heading south in the rain, we found a rather interesting QSO on WR6ABM. As we found out from our QSO, ABM is an open wide coverage repeater located in the Oakland area, designed to serve both the San Francisco Bay area and the Sacramento Valley. From what we noted, ABM fulfills its task quite well; we found ourselves able to access it for almost two solid hours. As usual, those we met on the air were warm, friendly, and always eager to give us any information we found ourselves in need of. When questions were asked about the system, there was always a sense of pride obvious in the response.

ABM seemed to be the home of the two meter SSB enthusiasts. Those whom I QSOed with were quite interested in finding out about SSB activity in the L.A. area (the number of people using that mode, the times they operated, and the most popular calling frequencies). We tried our best to supply the requested information, and I can only hope that a few good QSOs occurred consequently. It seems that SSB is going like wildfire up there, so if you are into that mode, you might give a listen down near the low end near 145 if you think you are within earshot of San Francisco (especially during that summer phenomenon known as VHF skip). Remember, for the past two summers running, Hawaii has been worked from L.A. on both FM and SSB. Why not San Francisco to who knows where? As you read this in July, the "season" is here, so if it's going to happen, it's probably now or never. Not that it be "E" or "F2" necessarily. Many of the most knowledgeable have come to the conclusion that the Hawaii to L.A. thing was ducting.

We were on .16/.76 and hunting for a place to eat when we became part of an existing QSO on WR6ADE. Almost immediately, a very warm welcome came our way from Dave WB6KHP, who informed us that ADE was located on Mt. Chual in the Santa Cruz Mountains, approximately halfway between San Jose and Santa Cruz. There is a definite order of responsibility among those who operate ADE. For the repeater to be operational, there must be a control station present. ADE has two control levels (as explained to me). At all times, a primary control station is monitoring the system (as Dave said, there are usually three or four). There is also a secondary level of control, and a secondary level control operator must be present and obvious or the system reverts away from open access. Therefore, as I understand it, ADE operates as an open system when both levels of control and responsibility are present, and as a limited access system at other times.

Hospitality on ADE? During the QSO I had with Dick, Ian, and the rest of the ADE people, a fellow Angelino, Jesse W6BFO, came on channel needing a phone call to the San Jose area. Ian had to leave, so Dave took secondary control and waited for Jesse to reach a point where he was solid into ADE. Then, using the ADE autopatch facility, Dave handled Jesse's traffic. Sitting back and listening to the patch, I was reminded again of what our hobby/service is really all about. While it was noted that the ADE autopatch is normally limited to use by their group, it is my opinion that their willingness to share with an outsider is really a positive statement for a rather fine group of fellow amateurs. We had reached a restaurant by the time the patch was completed, so we said our "73s" to both Dave and Jesse. Dave reverted the system to primary control, and Sharon and I went to lunch. At least I thought that's what had happened.

Some twenty minutes later, when we again took to the road, we found that WR6ADE was still up and that Jesse was in QSO with Al W6MEO. Heavens . . . was all of L.A. up here this evening? As I found out, as I left for lunch, Al, who had been up north, was en route back to L.A. about 15 minutes or so ahead of me. Another secondary control station had taken over, in order to enable Jesse and Al to continue their QSO. That's just another touch of the hospitality afforded by the WR6ADE group. Soon, however, as we drove south near Soledad, we found ourselves leaving the service area of WR6ADE.

From that point until we reached the area of San Luis Obispo, our 12 Watts and 12 channels proved futile, except for a few quick .94 simplex QSOs with fellow transients. We did finally manage to get in touch with Al, who by now was about a half hour in the lead, and decided that dinner was in order. We met at a Denny's along the road and took an hour's break from the concrete and asphalt to renew an old friendship.

According to some of the letters we received, we should have been able to be in almost constant repeater contact. However, such was not the case. To this day I can't tell you why. The following letter from Ernie WB6HJW, very indicative of some of the mail that part one of this story brought, is probably the most up-to-date info available on activity in that area.

Bill Pasternak WA6ITF
14725 Titus St. #4
Panorama City CA 91402

Dear Bill:

Just a short letter to let you know that amateur radio is alive and well in the Santa Maria area, despite what you indicate in your April column.

In Santa Maria we have a repeater (WR6AHZ, on 147.81/.21) which has been in operation since 1974. WR6ASW, 146.34/.94, is now located on a hilltop south of Santa Maria, although I believe it was at ground level when you made your trek north. WR6AEL, 146.22/.82, is located on Cuesta Grade (north of San Luis Obispo) and covers from Camp Roberts to Buellton. WR6ADS, 146.16/.76, is on the campus at Cal Poly (San Luis Obispo). WR6AVI, 147.72/.12, is on Harris Grade, near Lompoc, covers from San Luis Obispo to south of Buellton, and has been on since 1973 (formerly as WR6AEB). WR6AFI, 147.60/.00, is on Broadcast Peak above Santa Barbara, and covers from Paso Robles to the Mexican border (of course, not solidly).

WR6AHZ has autopatch into Nipomo, Arroyo Grande, Grover City, Pismo Beach, San Luis Obispo, Avila Beach, Baywood Park, and Los Osos. WR6ASW has autopatch into Santa Maria, Guadalupe, Nipomo, and Los Alamos. WR6AVI has autopatch into Lompoc and Vandenberg Air Force Base.

There are other repeaters in the Santa Barbara area (on 146.31/.91 and 146.19/.79) which are accessible south of Gaviota.

All repeaters in San Luis Obispo and Santa Barbara counties are open, and persons passing through the area are welcome to use them. Repeater use is monitored by control stations, but I have never heard any control operator interfere with any amateur's lawful use of a repeater. Most area repeaters are on 24 hours a day.

I hope on your next trip north (maybe for the Southwestern Division ARRL Convention to be held in Santa Maria, Oct. 7-8-9) that you find this area more hospitable on two meters and that you won't have to resort to CB to talk to someone. With almost 200 amateurs in the area on two meters, the repeaters are jumping.

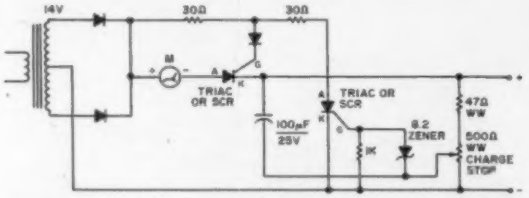
Ernie Kapphahn WB6HJW
Santa Maria CA

We wish to express our gratitude to

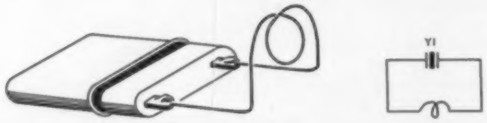
Continued on page 167

Circuits²

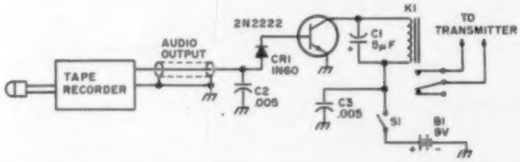
Want a free copy of any 73 publication? Sure you do. Just send in your favorite circuit, or even one that you don't especially like. If we print it, you take home the book of your choice. Just be sure to specify which book you want. OK?


14V
30Ω
30Ω
M
A
K
G
TRIAC OR SCR
100μF 25V
A
K
G
TRIAC OR SCR
1K
8.2 ZENER
47Ω WW
500Ω WW CHARGE STOP
+
-

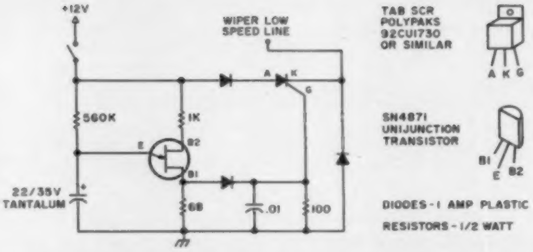
An automatic shutoff battery charger which will not dry out batteries. Must be adjusted by setting 500 Ohm resistor while attached to a fully charged battery. Thanks to W6ZNX.



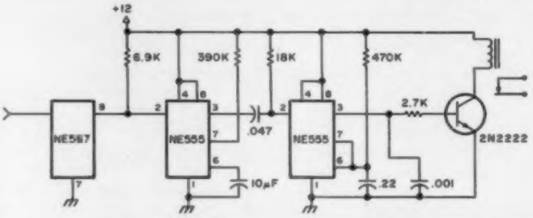
The simplest circuit yet for checking crystals. Attach a one-turn coil to a crystal socket and plug in the crystal. A grid dip meter coupled to this turn will dip at the resonant frequency. Thanks to W5QFH.


TAPE RECORDER
AUDIO OUTPUT
C2 .005
2N2222
CR1 1N60
C1 5μF
K1
TO TRANSMITTER
C3 .005
S1
B1 9V

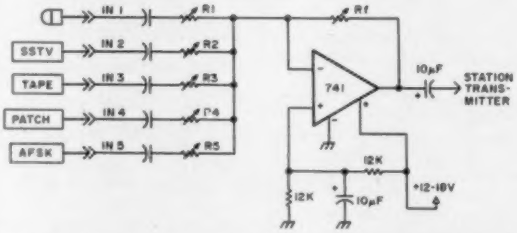
The tightwad special keyer memory for contest types needing memory for CQs and so on, but unwilling to assemble the conventional type. Construction and operation are simple, but be sure to keep stray rf out of the system through shielding. An audio oscillator is keyed into the microphone of the recorder and put on tape. Then the recorder is rewound and played into the circuit. Sensitivity is adjusted at the output of the recorder. Thanks to WB8TSY.


+12V
WIPER LOW SPEED LINE
A
K
G
560K
1K
E
B2
B1
22/35V TANTALUM
68
.01
100
TAB SCR POLYPAKS 92CU1730 OR SIMILAR
A K G
SN4871 UNIJUNCTION TRANSISTOR
B1
E
B2
DIODES - 1 AMP PLASTIC
RESISTORS - 1/2 WATT

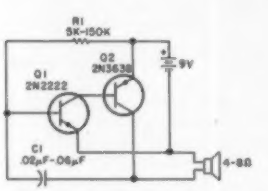
A good way to set your windshield wipers on an interval circuit. Only two connections to the car's wiper control, plus ground, are required. Variable control can be accomplished by substituting a 500k pot in series with a 100k fixed resistor in place of the 560k. Thanks to VE3OE.


+12
6.9K
390K
18K
470K
NE567
8
7
NE555
2
3
4
8
7
6
1
10μF
.047
NE555
2
3
4
8
7
6
1
.22
.001
2.7K
2N2222

This circuit was designed to give about eight seconds worth of delay after a reset tone is applied to the control receiver of a remote base. A tone can be applied for 1 or 2 seconds without appearing on the transmitter output. Thanks to W7CJB.

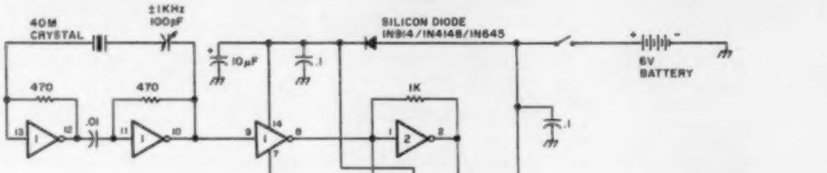

IN 1
R1
SSTV
IN 2
R2
TAPE
IN 3
R3
PATCH
IN 4
R4
AFSK
IN 5
R5
Rf
741
10μF
STATION TRANS-MITTER
12K
12K
10μF
+12-18V

Here's a good way to input several audio sources to your station transmitter. It's an op amp in the "summing amplifier" mode. Overall gain is set by Rf while individual inputs are adjusted by their respective controls. Thanks to K7HKL.

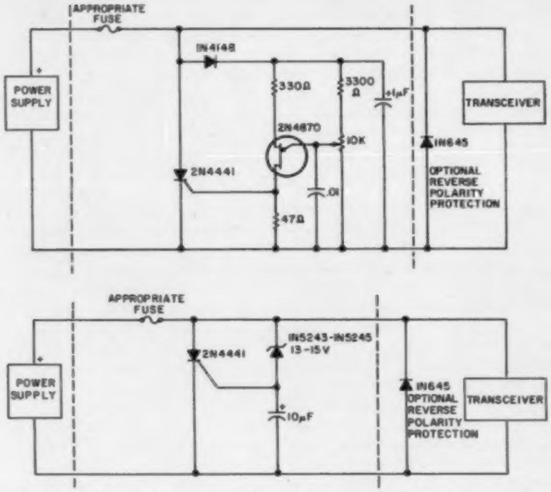

R1 5K-150K
Q1 2N2222
Q2 2N3638
9V
C1 .02μF-.05μF
4-8Ω

A good audio oscillator circuit. Almost any transistors will work, while R1 and C1 will vary the tone. The circuit has been used to find the correct pins on unknown transistors and as a simple test for good or bad. Thanks to M. S. Reid WA3JEF.

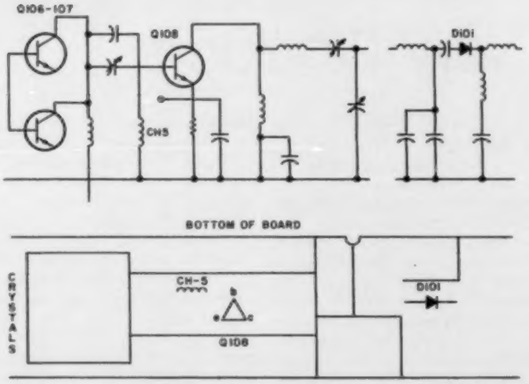
News? We need input, and one of the best sources is the club newsletter. Got one? We reiterate our longstanding offer of a free subscription to 73 or Kilobaud in exchange for a spot on your ham or computer club newsletter mailing list. Deal?


40M CRYSTAL
±1KHz 100pF
10μF
.1
SILICON DIODE 1N914/1N4148/1N645
6V BATTERY
470
470
.01
1K
.1
20 TURNS NO. 24 MAGNET WIRE BIFILAR T-68-2 CORE
.1
TO 50-75Ω ANTENNA
365pF (OPTIONAL, FOR HARMONIC SUPPRESSION)
IC1 - 7404
IC2 - 7405/7406
1μF 20V
1K
PITCH
.47
SIDETONE OUT
500Ω
OR
HI-Z
KEY
.1

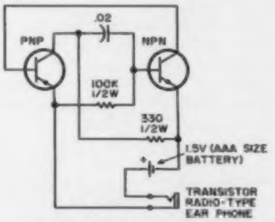
A super cheap 40m CW transmitter with sidetone monitor. Rf output is about 250 mW, and the cost should be under $5. Thanks to WB4CTC.


APPROPRIATE FUSE
POWER SUPPLY
1N4148
330Ω
3300 Ω
1µF
2N4870
10K
2N4441
.01
47Ω
1N645
OPTIONAL REVERSE POLARITY PROTECTION
TRANSCEIVER
APPROPRIATE FUSE
POWER SUPPLY
2N4441
1N5243-1N5245
13-15V
10µF
1N645
OPTIONAL REVERSE POLARITY PROTECTION
TRANSCEIVER

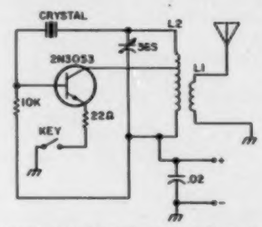
A way to avoid grief when using 12 V power supplies with mobile transceivers. Most p.s. circuits leave room for a short circuit failure of the series pass transistor, which will do a job on your rig! Here are two crowbar circuits which will deliver protection by clamping the power line and blowing the fuse within microseconds of the beginning of an overvoltage condition. The idea here is to incorporate the crowbar directly into your transceiver, thus protecting the radio wherever you go with it. The chief difference between the two circuits is that the less complex of the two leaves you at the mercy of component tolerances for the exact trigger level, while the other includes a unijunction trigger to permit precise setting of the operating point. Thanks to W1DGD.


Q106-107
Q108
D101
CH5
BOTTOM OF BOARD
CRYSTALS
CH-5
b
c
e
Q108
D101

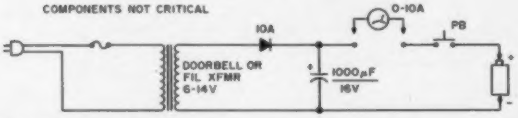
Wilson 1402 HT modification for those experiencing problems with diode D101. First replace choke 5 with a 100 Ohm resistor, then add a 25 pF capacitor from the base of Q108 to ground, and finally replace diode D101 with a jumper wire. Thanks to W8URX, through the LEARA *Newsletter, CA.*


.02
PNP
NPN
100K 1/2W
330 1/2W
1.5V (AAA SIZE BATTERY)
TRANSISTOR RADIO-TYPE EAR PHONE

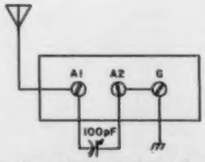
The simplest transistor checker yet! Choose a general purpose PNP/NPN and construct in a plastic box or small container. Color code the transistor and its socket. To check a suspect device: no tone, ng; low tone or chirp, so-so; steady tone, OK. A great circuit for matching transistors. Thanks to Bill Wentzel W3GWA.


CRYSTAL
L2
365
2N3053
L1
10K
22Ω
KEY
.02

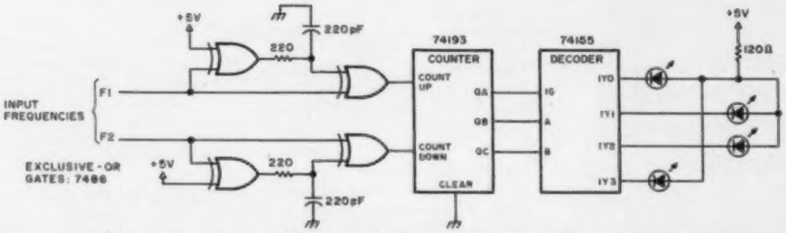
Another QRP transmitter, this time using a 2N3053 and fundamental crystals. Runs about 2 Watts output. Thanks to WB6OMV.


COMPONENTS NOT CRITICAL
0-10A
10A
PB
DOORBELL OR FIL XFMR 6-14V
1000µF 16V

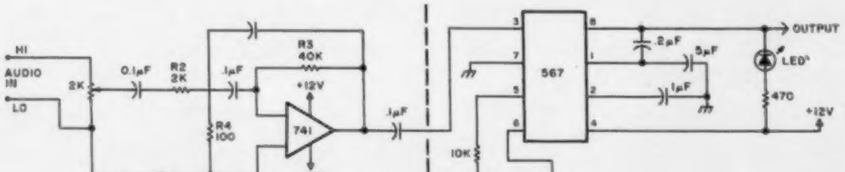
The nicad zapper used to restore dead or bum nicads. To operate, connect nicad to output and press button for 3 seconds. Thanks to K6JQD.


A1
A2
G
100pF

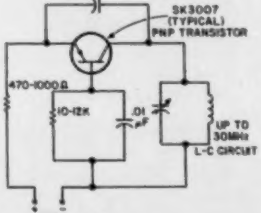
Many low-priced receivers for the 160-10m amateur bands do not have an antenna trimmer control. To peak up reception on your favorite band, mount a small variable capacitor (100 or 140 pF) at the antenna terminals on the rear of the receiver, as shown. Tune the capacitor for a maximum reading on the S-meter. For a more permanent arrangement, the capacitor may be mounted inside the receiver cabinet and tuned from the front panel by an extension shaft and knob. Thanks to W3WTO.


+5V
220pF
220
74193
COUNTER
COUNT UP
QA
QB
QC
COUNT DOWN
CLEAR
74155
DECODER
1G
A
B
1Y0
1Y1
1Y2
1Y3
+5V
120Ω
INPUT FREQUENCIES
F1
F2
EXCLUSIVE-OR GATES: 7486
+5V
220
220pF

This circuit uses LEDs to display the beat frequency of two-tone oscillators. Only one LED is on at a time, and the apparent rotation of the dot is an exact indication of the beat frequency. When f1 is greater than f2, a dot of light rotates clockwise; when f1 is less than f2, the dot rotates counterclockwise; and when f1 equals f2, there is no rotation. Thanks to WB8TFN.


HI
AUDIO IN
LO
2K
0.1µF
R2 2K
.1µF
R3 40K
+12V
R4 100
741
-12V
800Hz ACTIVE FILTER
.1µF
3
7
5
6
567
8
1
2
4
.2µF
5µF
1µF
LED
470
+12V
OUTPUT
10K
5K
.1µF
567 PLL TONE DECODER

Here's a Morse code decoder for the handicapped. It will copy very weak signals due to the narrow bandpass of the active filter on the PLL input. This can be powered by two 9 volt transistor batteries. Thanks to WA5SWM/5.


10-100µµF
SK3007 (TYPICAL) PNP TRANSISTOR
470-1000Ω
10-12K
.01 µF
UP TO 30MHz L-C CIRCUIT
3V

An rf oscillator useful up to 30 MHz. An SK 3007 PNP transistor is recommended. Thanks to WA5RON.

New Products

VHF ENGINEERING BLE 10/80 UHF AMPLIFIER

At last! VHF Engineering has announced, and is delivering, their latest contribution to VHF-UHF enthusiasts. The new product line consists of a series of UHF (420-470 MHz) power amplifiers, capable of producing up to 80 Watts output. The new "Blue Line" amplifiers, with a distinctive blue aluminum finish, are unique in that they may be switched between class C FM service and linear SSB service, rendering them useful for both FM and CW rag chewing and OSCAR SSB/CW QSOs. (Remember, no FM through the satellites!) Blue Line amps are available in two power ranges. Two models produce 40 Watts with either two or ten Watts of input, respectively. The other two amplifiers require ten or thirty Watts of drive to produce 80 Watts.

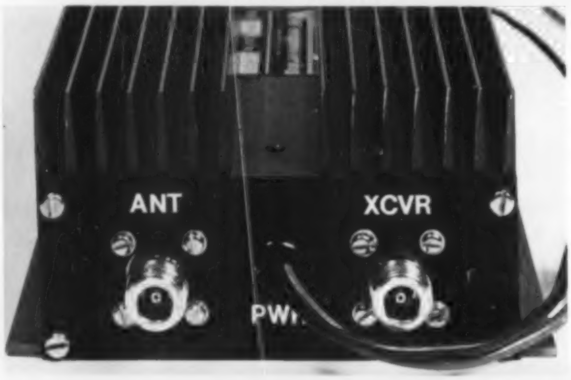
I tested the BLE 10/80, which can be considered the "top line" UHF amp provided by VHF Engineering. I am an avid UHF enthusiast, and awaited the arrival of the package from VHF with much expectation. I was impressed with the quality of the unit.

Measuring 9" x 6" x 3", the BLE's exterior is one massive heat sink. One-inch fins traverse the length of the unit, and the power transistors are mounted upside down on the inner surface of this plate. Input and output connectors are type "N" males, required at these operating frequencies. Two rocker switches are mounted in the other end of the chassis. One is an illuminated power switch that controls the internal drive-sensing relay. The other selects the BLE's mode. The user may select either FM (CW) or SSB. When drive is applied in the SSB mode, both lamps are illuminated, indicating linear operation. The lamp in the SSB switch is also part of the bias network, and must be replaced if it does not light in the SSB mode. About three feet of stranded no. 12 power wire extends from the amp. The positive lead is fused with a 20 Amp fast-acting fuse. A note about power supply connections is in order at this time. Don't scrimp! The 80 Watt amplifiers can draw 15-18 Amps at 13 volts. Power supply leads must be at least no. 12 wire and should be as short as possible, connected directly to the car battery or a very healthy bench supply. Connecting this amp to cigar lighters or under-the-dash wiring can cause serious automotive fire hazard, as that wiring is not capable of handling the current required by the BLE 80. I used a battery from a small tractor as the initial power source.

The BLE was tested on the bench prior to mobile testing. The test setup consisted of an Icom 30A UHF FM transceiver capable of providing 10 Watts of output from 440-450 MHz. A Bird Model 43 was inserted in the input line, and another Bird was placed between the BLE's output and a perfectly matched quarter wave whip cut for 446.0. I fired up the Icom and noted that it was delivering 8.5 Watts to the BLE. The output meter indicated a rock-crushing 82 Watts into the line. I repeated this test with the mode switch in the SSB mode, and noted that the power output decreased by 8 Watts. It appears that the specifications relating to the BLE's power producing capability are conservative, as tweaking the final of the Icom to match the input of the BLE resulted in 95 Watts out for 10.5 Watts of drive. Next, key-down test was tried. VHF Engineering warns that the BLE will get very hot under continuous duty conditions when the ambient temperature is high. They also indicate that power transistor life is directly related to operating temperature. I drove the BLE 10/80 at full power for five minutes, after which time the case was very warm, but not too hot to touch. My tractor battery also dropped to 10 volts from its previous 12 volt level. Enough! While the battery voltage was steady, the power output dropped only 12 Watts as the amp heated.

Vhf engineering
OFF
ON
FM
SSB
RF POWER AMPLIFIER

The VHF Engineering BLE 10/80.



SSB was tried next. A KLM 70 transceiver was used as the driving source at 432 MHz. Again, no problems. The well-damped Bird meter indicated an average output of about 50 Watts, which resulted from close talking the Echo's microphone at above normal speech levels. I was unable to contact another station on simplex, due to the lack of activity on 432 in this area. However, I plan on taking the combination of BLE 10/80 and Echo 70 to the Boston or New York area for direct SSB tests. An obvious use of the BLE in the SSB mode is as an OSCAR uplink booster. Although the 80 Watt output is too much when using gain antennas for OSCAR, the power is about right for simple turnstile and groundplane antennas, which eliminate the need to track OSCAR with the uplink antenna system.

The final test of the BLE 10/80 was a mobile one, using the Icom 30A as an FM driver and a Larsen mobile collinear (6 dB) mounted on the roof. My favorite 450 repeater in the area is WR1ABU in Concord NH. Using the Icom barefoot, I had pretty much established my useful range on transmit in the surrounding area. With the BLE in the line, my coverage about doubled over the hilly New Hampshire terrain. I was able to access the repeater in places where I could only hear it previously using the 10 Watt Icom output. The same results were achieved on 446 simplex, with Rich WB1ASL on the other end with his reference beam.

Although it cannot be claimed that using a 10 to 80 Watt amp will always double your coverage, it sure helps, especially on UHF where trees and leaves have a large detrimental effect on signals. I connected the BLE directly to the battery on my vehicle, using the no. 10 wire that also feeds my 2m amp. No problems were encountered, and the voltage at the BLE under key-down FM conditions was 12.8 with the engine at idle. I would not recommend using anything less than no. 12 wire for a mobile installation (that includes a BLE 80).

I am currently building an OSCAR mode B station which will feature the BLE driven by the Echo 70. I plan on using simple antennas that will allow the use of full power without overloading OSCAR. I also plan on subjecting the BLE to spectrum analyzer tests with an eye toward SSB performance. However, no evidence of any spurious output was noted in the operating tests. The BLE is also unconditionally stable with no sign of oscillation. When the drive stops, so does the output!

I enjoyed using the BLE 10/80, especially on FM where it enabled me to access a distant repeater reliably in my travels around Peterborough. There is no compromise in quality with the BLE. The unit is mechanically and electrically solid, and the use of "N" connectors is a touch of class in this day of corner-cutting. The Blue Line UHF amps by VHF Engineering should be well received by the UHF community, and justifiably so! *VHF Engineering, 320 Water St., Binghamton, NY 13901, $289.95.*

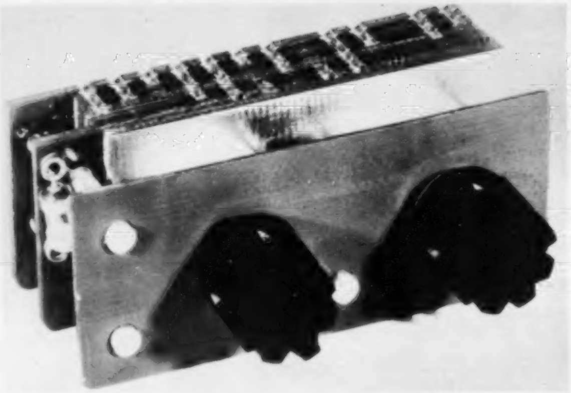
John Molnar WA3ETD
Executive Editor

NEW ROLLABALL MULTIMETER SWITCHES

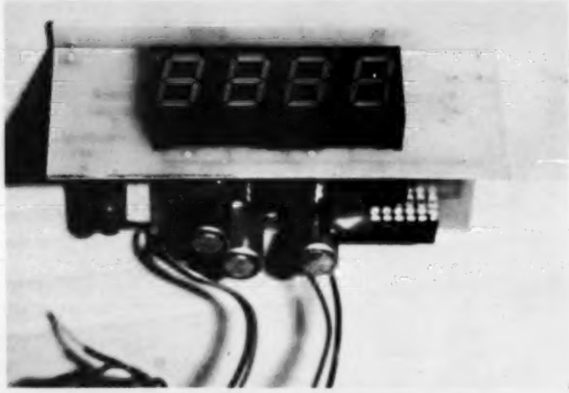
At present, Non Linear Systems digital multimeters employ miniature switches which are used for range and function control. These, being mechanical parts, have been subject to normal wear and conceivably could be subject to the earliest failure of all of the parts in a solid state meter. Furthermore, as the time approached for introducing an internal current function in the Volksmeter products, it was found that no truly miniature switch was available which had an adequate current carrying capacity.

In turning to the NLS R&D department for a solution, an entirely new concept for miniature rotary switch implementation has been conceived. NLS "Rollaball" switches (as they are called) overcame many of the difficulties experienced in conventional rotary switches. Because the moving part is a ball plated with precious metal, contact wear is reduced to a minimum. The precious metal plating on both the fixed and moving contacts is not worn away. Detent action is derived simply by using a few wear-free parts.

No complex, subject-to-failure, detent mechanism is needed, and generous amounts of contact area promote low contact resistance and high current carrying capacity. The use of glass epoxy and Delrin insulating materials assures low leakage and high insulation resistance, both necessary characteristics in a quality digital multimeter. "Rollaball" switches have extreme reliability and long life. Life testing is not completed, however: Units are still functioning perfectly after more than



An end to miniswitches in digital multimeters — new "Rollaball" rotary switches from NLS.



The Gary McClellan and Company Model 101 DVM kit.

1,000,000 operations (130,000) revolutions. The set of switches in NLS multimeters measure only 1" high x 2" wide by 1" deep. No external jumper wires are used, eliminating the bending and breaking of wires. The multimeters themselves must be able to operate from 100 microvolts to 1000 volts and from 10 nanoamperes to one Ampere (with accuracies as great as 0.02%). Long-life "Rollaball" switches now make this more easily attainable. *Non Linear Systems Inc., PO Box N, Del Mar CA 92014.*

NEW HARRISON CATALOG

A new full-line catalog has been announced by Harrison Radio Corporation. The catalog, available in June, will cover amateur radio equipment and accessories, as well as CB and public service monitor equipment. The catalog is free, and a copy can be reserved by writing *Harrison Radio Corp., 20 Smith St., Farmingdale NY 11735 — Attn: Chas. Anzman.*

MODEL 101 DVM KIT

Gary McClellan and Company has just introduced a low cost digital voltmeter kit, the Model 101. This unit features the low price tag of only $29.95 each, making it possible for more people to have their own DVMs.

The Model 101 has many other features besides price. The circuitry uses the latest CMOS ICs and the latest DVM design, bringing such advantages as low power consumption, auto zero, and much more, at a rock-bottom price. There are 3½ digits of beautiful half inch high LED readouts to display voltages, and a minus sign to indicate that negative voltages are being read. The circuitry of this hand-sized unit consists of three ICs and a few external parts. They combine to make a meter that reads from 0 to ± 1.999 volts, with readings of 0 to 199.9 millivolts possible with two easy circuit changes. This DVM zeros itself automatically before each reading. There is only one calibration control, and calibration can be done in minutes. Accuracy can be as good as 0.05% or better. Power is a single 5 volts dc and the unit may be easily run off 4 "A" size nicad batteries.

Gary McClellan and Company also offers as options a quality ac/Ohms board (to make a complete digital multimeter) and a four range attenuator (which allows readings up to 1200 V dc). A thermometer board option is in the works, too. Write for details to *Gary McClellan and Co., Box 2085, 1001 W. Imperial Highway, La Habra CA 90631.*

NEW HEATHKIT CATALOG

The latest Heathkit catalog lists nearly 400 electronic products in kit form. Among new products featured in the catalog are a 3 band UHF/VHF scanner, a matching stereo tuner and amplifier, a five function aircraft clock timer, and a programmable home heating control (which is said to save up to 10% on home heating bills). The catalog also describes nearly 400 other electronic kits, including automotive and marine accessories, amateur radio equipment, test instruments, learn-at-home electronics courses, stereo equipment and color TVs. The catalog is available free from *Heath Company, Dept. 350-13, Benton Harbor MI 49022.*

10544B
CRYSTAL OSCILLATOR
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10544C
CRYSTAL OSCILLATOR
EFC
OVEN MONITOR
11 TO 13.5V
20 TO 30V
10MHz

Hewlett Packard's new 10 MHz component crystal oscillators.

PRECISION 10 MHZ COMPONENT CRYSTAL OSCILLATORS FOR HIGH QUALITY APPLICATIONS

Ideal for high quality instrument and communications and navigation systems applications, these compact 10 MHz crystal oscillators feature high spectral purity and fast warm-up at competitive prices. Using a new dc oven controller, the oscillators achieve a very low aging rate of 5 parts in 10^{10} per day, spurious phase noise less than 150 dB for more than 1 kHz offset, and warm-up to within 5 x 10^{-9} of final value in 20 minutes.

Two rugged, compact oscillators are introduced — Hewlett-Packard models 10544B and 10544C. The Model 10544B uses a printed circuit board connector, while Model 10544C has filter feedthrough terminals, a snap-on rf connector for 10 MHz output, and provision for shock mounting. These oscillators are rugged enough for use in field equipment. Environmental performance, including magnetic and gravitational, are fully specified. Both units measure 72 mm x 52 mm x 62 mm (2-13/16" x 2-1/32" x 2-7/16"). They weigh 0.31 kg (11 oz.). *Hewlett Packard, 1501 Page Mill Road, Palo Alto CA 94304.*

FAIRCHILD INTRODUCES TWO TECHNOLOGY KITS

Two new solid state Technology Kits™ — a digital alarm clock/calendar and a digital wall clock — have been introduced by the Opto-

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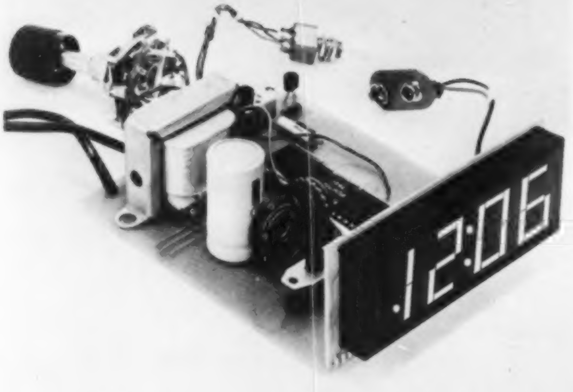
New
New
New
New
New
HEATHKIT
MAIL ORDER CATALOG 818



The Fairchild 0100 clock/calendar Technology Kit™.

electronics Division of Fairchild Camera and Instrument Corporation.

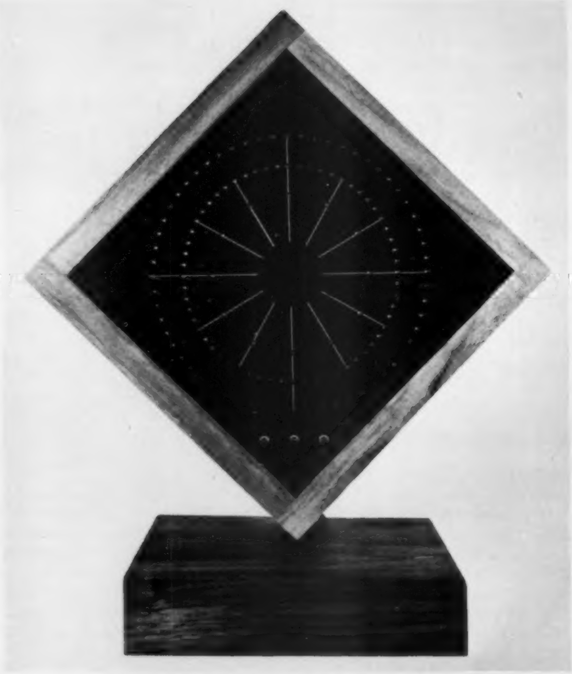
The 0100 alarm clock/calendar features an .8 inch, 3½ digit LED display with am/pm indicator. The clock, which displays time for eight seconds and date for two seconds, has connections for radio applications and may be connected to a nine volt battery.

The 0101 wall clock uses a 2½ inch, 6 digit LED display comprised of 175 LED lamps. The display, visible at up to 50 feet under normal conditions, alternates between time and date. If desired, constant time or date readout can be selected. The wall clock can also be connected to a radio with direct current for an external speaker, and contains programmable alarm features. *Fairchild Camera and Instrument Corporation, 4001 Miranda Ave., Palo Alto CA 94303.*

NEW AMELECT CLOCK

A new, revolutionary concept of displaying the time of day by means of the position of illuminated light emitting diodes (LEDs) in three concentric rings on a mirror-like acrylic face has been announced by Amelect, Inc.

These clocks, three years under development, are available in four styles and several kinds of solid hardwoods: walnut, mahogany, maple, cherry, and light and dark oak. The modern clock face is made of 1/8" acrylic with scribed markings to identify time positions. There are no moving parts, gears, motor, or hands. An outer ring of sixty lamps indicates seconds, and each successive illumination takes place at one second intervals. The middle ring of sixty lamps indicates minutes and changes each time the sixtieth second is illiminated. The inside ring of twelve lamps indicates hours and changes when the sixtieth minute lamp is illuminated. Actual time is shown by position of the three lamps that are illuminated at the given instant of reading. *Amelect Inc., P.O. Box 367, Goodland IN 47948.*



The Amelect CL 7401A with base.

NEW VHF ENGINEERING 30 AMP POWER SUPPLY

The PS-3012, a high current, 13.8 V regulated power supply originally designed for commercial two-way radio applications, is now being introduced into the amateur market by VHF Engineering of Binghamton NY. This power supply has been designed for demanding commercial applications through the use of a heavy duty transformer, dual heat sinks, and ruggedized case. The PS-3012 delivers 30 Amps at a 50% duty cycle, and 20 Amps at a continuous duty cycle.

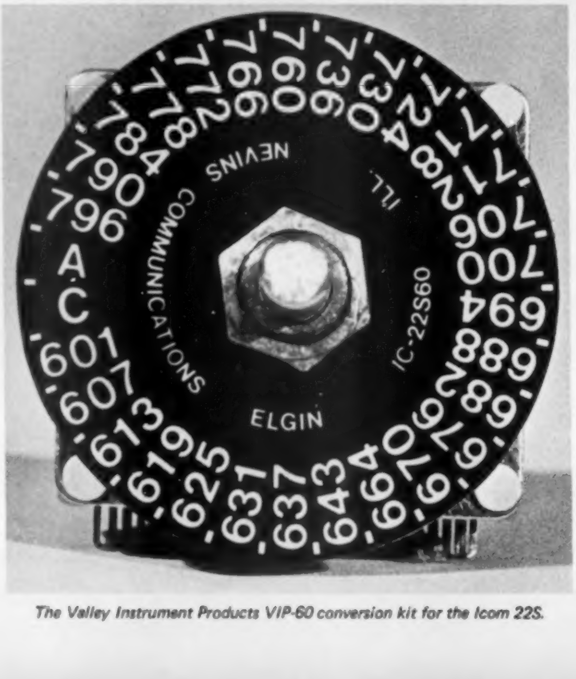
The PS-3012 is available for $239.95 as a wired and tested unit from *VHF Engineering, 320 Water St., Binghamton NY 13902.* A rack mounted version is available as an option.

VIP-60 CONVERSION KIT

Valley Instrument Products of Bartlett IL has introduced a new programming device for the popular Icom 22S 2m transceiver. The VIP-60 conversion kit offers 56 preprogrammed frequencies, including all standard repeater channels, plus any four additional frequencies you choose. *Valley Instrument Products, P.O. Box 339, Bartlett IL 60103.*

Continued on page 106

The VHF Engineering PS-3012.



The Valley Instrument Products VIP-60 conversion kit for the Icom 22S.

ME-3 microminiature tone encoder

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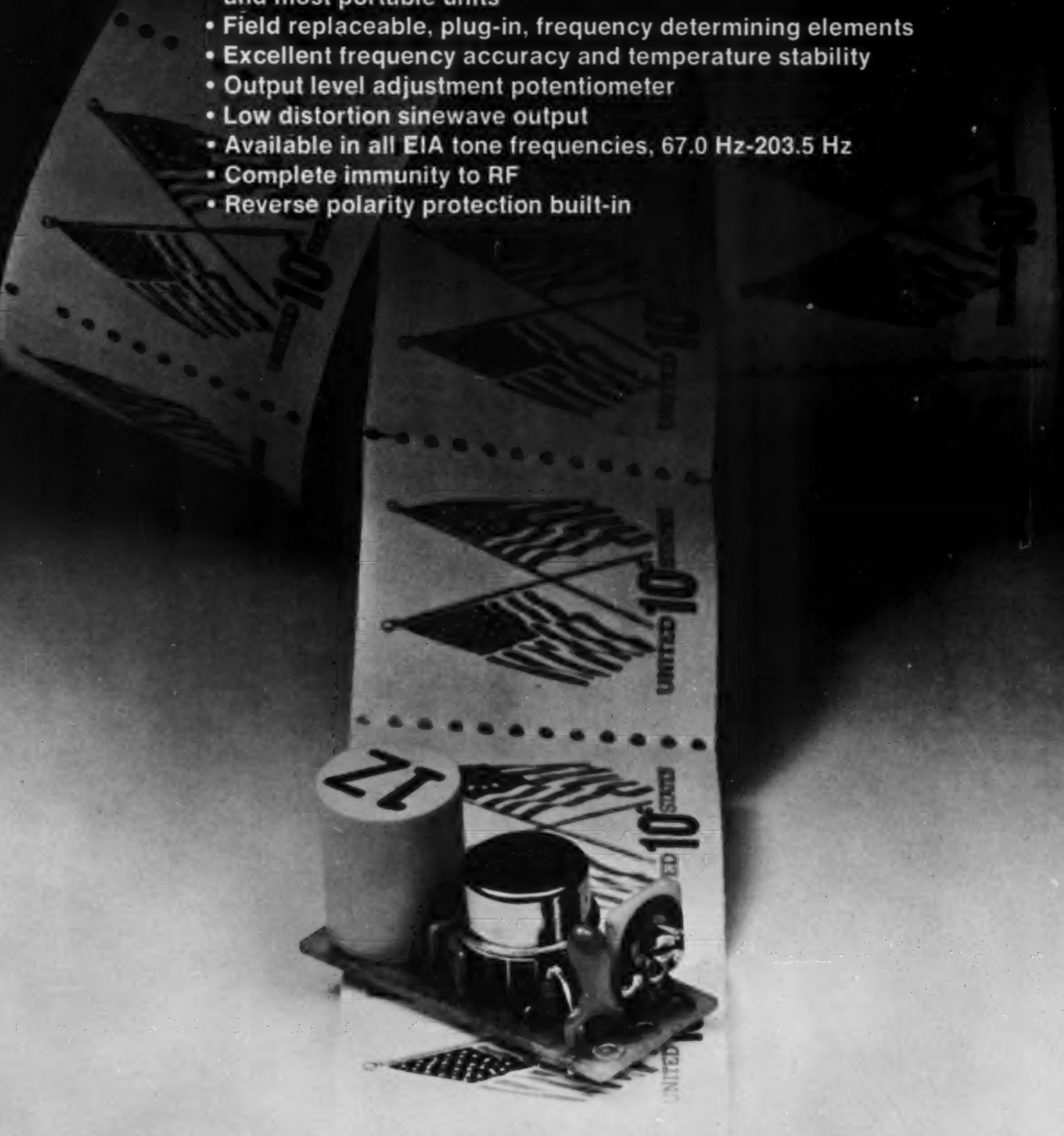

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Motorcycle Mobile

- - combining summer pastimes

The great outdoors. The clean air. You, riding off down the road, the wind in your face, on your trusty motorcycle heading off into the sunset. Ah, freedom! But the specter of a chain breaking, plugs fouling, or a tire going flat and you twenty miles from nowhere looms nearby. Anyway, riding around with all that freedom is lonely. There's no one to talk to. Even if you are with a group of people communication is limited to waving arms and sign language. There is a better way! Whether it be CB, HF, or two meter FM, motorcycle mobile is the answer to getting more fun from your bike.

First you have to decide what type of rig you are going to use. Unless your motorcycle has the battery and electrical system of a Harley-Davidson, you are limited to the many transistorized mobile or portable radios on the market.

The obvious answer is the handie-talkie. It's nice and small, very portable, has its own power supply, and is hand-held. Wait a minute! How are we going to go down the road using only one hand to operate the bike?

Well, maybe you could use a belt clip and some sort of external microphone/speaker combination like the law enforcement motormen use. This is OK if you don't mind your $200-$400 talkie flapping about on your hip, exposed to the elements (maybe bouncing down the road behind you?) plus the extra cash for buying the external microphone/speaker box. Anyway, how are you going to key the thing while under way? It looks like the obvious answer needs some rethinking.

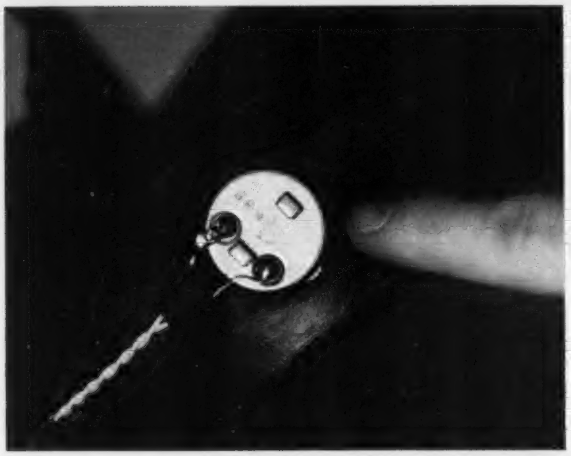
OK, how about using that larger mobile rig? Well this, believe it or not, has got possibilities. The next question is, where am I going to put it?

It has got to be handy, so some place up front would be nice. Putting the rig on the handle bars might work, but you would have to fabricate some sort of exotic mount for it, not to mention covering up the instruments (in the case of the speedometer, this would be costly) and adding extra mass to the front fork assembly which could be dangerous to the bike's handling characteristics.

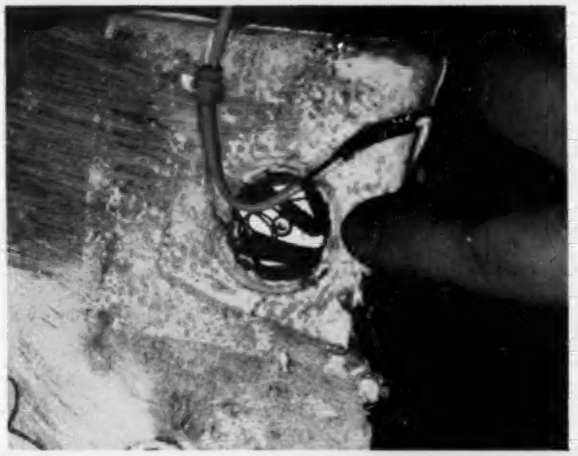
A tank bag would work fine. This is a bag (approximately 12" x 8" x 8") of leather or vinyl material that straps on top of the gas tank. The bottom is padded so it won't scratch your paint job and the whole bag unbuckles in seconds so you can take it with you. It was designed for carrying one or two changes of clothes with you on a short trip. It is usually waterproof too. The cost is about $40.

The best alternative is the space inside of a good frame-mount fairing. A fairing is a combination windshield/cowling protective device made from ABS plastic or fiberglass, which protects the rider and bike from the elements and road hazards. One week after I had bought a new 550 four cylinder Honda with a Windjammer fairing, a curb that was lurking in the dark jumped out in front of me. I broke the windshield in the resulting crash. The windshield had to be replaced, but the fairing, which was just a little

Motorcycle mobile — note connecting cord from helmet.



Rear view of front crash padding removed from helmet showing rear of microphone.



Styrofoam helmet liner showing earphone and cord detail.

bit scratched, had saved me and, more importantly, my new motorcycle from any damage. So at about $300 they are worth the money. Besides, the fairing has lots of storage space inside which is protected from the elements. Most mobile rigs will easily slide into one side of a fairing leaving still more room for extra microphones, headsets, and rain gear.

Now that we have the rig attached to the machine, how do we use it? First, we will have to make some sort of arrangement for a speaker. You may be able to use the rig's internal speaker if it's on the front or top of the rig and you are using a tank bag. If this is not the case, then an external speaker jack must be installed in the radio.

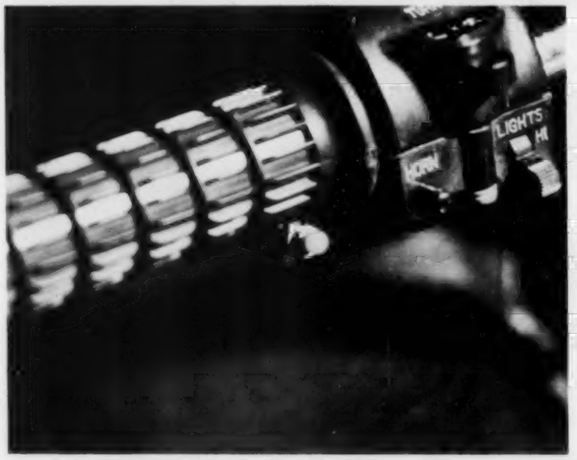
Now you have a couple of options: a speaker mounted on the handle bars, or an earphone/headset under your helmet. I went the speaker route first. It worked all right, but the rig has to be turned up so loud to override the sound of the motor, wind noise, and the natural attenuation of my helmet, that late at night I was in danger of being cited for disturbing the peace. Next, I tried a transistor radio earplug. This only had two problems: The audio quality was nonexistent, and I did not like the feeling of that "thing" in my ear. I then decided to modify my helmet. I will get into the helmet modification a little later.

After solving the speaker problem, the microphone problem is next. If you are using any helmet other than a full coverage type (one that comes down in front of your mouth and chin with a large slot for you to see out of), you can use a hand-held microphone with good success. Just drape it over the handle bars and (unless you want to use the clutch lever) pick it up, put it under your face shield and talk. The face shield really cuts down on the amount of wind noise that gets picked up by the microphone. Working the microphone close to your mouth helps, too. (You won't have any choice if the microphone is between you and the faceshield.) Using the hand-held microphone also eliminates the push-to-talk switch (PTT) problem that we are about to run into.

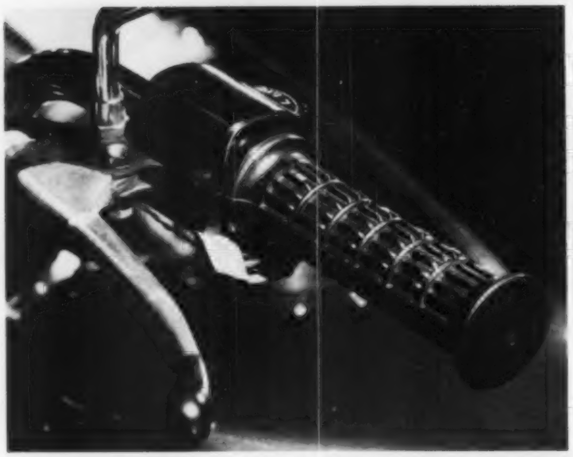
If we do not use the standard microphones, then we have a few problems: Where are we going to put the PTT, and how are we going to hang the microphone in front of our mouth for hands-off operation? Now we get into how to modify your helmet.

All good helmets have lots of crash padding inside. Usually it's styrofoam and foam rubber. The main protection over the head is the one half to one inch thick styrofoam. Foam rubber is sometimes used in front of the mouth in full coverage helmets and in a few other places such as around the ears. What most people don't know is that you can take the padding completely out of the fiberglass or plastic shell of the helmet. The padding is generally in two pieces, split from front to back down the middle. The crack may be covered up by a small decorative strip and/or a piece of foam rubber. Now comes the fun! You have to work one of the styrofoam halves out of the helmet shell. If you are careful and persistent, you will emerge victorious in this little bout with your helmet. The liner will be a bit stubborn, possibly because some of the cheaper helmets may use a little rubber cement to hold it inside the shell, but forge ahead! Remember, if it's a cheap helmet, they are too cheap to use a lot of glue on it.

Once you get the first half out the other side will probably fall out. Now you can start the real modifying. I took an old headset that had a boom microphone on it and canabalized it. The earphone element was about 1.5 inches in diameter and about ½ inch thick. I then cut a hole in the styrofoam next to my ear and pushed the element into the hole. Since my element used a plastic membrane for its



PTT switch and bracket. Front view.



PTT switch and bracket. Rear view.

Helmet jacks mounted in fairing.

diaphragm, I put a hard plastic cover over it. The guard was a retaining cover from an old telephone type carbon microphone on a boom that telephone operators used to use. It just happened to fit over my earphone element. Anything that has holes in it that will prevent damage to the diaphragm can be used. I then ran the wires out the back of the liner. First, though, you can use a razor blade to cut a shallow trough in the styrofoam (the side that will contact the hard shell of the helmet) for the routing of the microphone and earpiece wires out of the helmet.

If you have a full coverage helmet, you can use the same procedure to mount a microphone element in the padding in the front of the helmet. For all other types of helmets you must make up some sort of microphone boom. The boom can be made with brass tubing from a hobby shop (approximately 1/8 inch diameter) bent into a smooth, gentle curve. The end of the boom where the wires come out can be epoxied into the styrofoam after a suitable trough has been notched out for it. Be careful about using glues on styrofoam. It may melt. Rubber cement may be better than epoxy.

Finding a suitable microphone element was the hardest part of the project. I had a small dynamic microphone element that came out of an old headset that I had salvaged the earphone and cord from, but the element was bad. After scrounging in many other people's junk boxes to no avail, I finally went to the local Radio Shack. There I found brand new replacement CB microphones (dynamic and ceramic) for only $8, which was about $3 to $4 cheaper than the replacement element I could get for my Sure microphone. Also, the element in the microphone from Radio Shack was only about ¾ of an inch in diameter. This would fit very nicely into the crash padding in the front of my helmet.

Rig going into place in fairing.

After you get all the elements in place in the crash padding, use some duct tape to keep it all from falling out before you get the liner back inside the helmet. Now all that's left is to put a jack in the fairing for the helmet to plug into and, oh yes, the PTT switch.

I tried two methods for PTT. The first is usable but is almost like using a hand-held microphone. I epoxied a small push-button normally open switch (five for $2 at Radio Shack) into an inverted cover that screws over a ¼ inch phone jack, and ran the wires out the smaller opening in the opposite end. I would then attempt to grab this assembly while motoring around town. I never realized that it was so small. After about two weeks of attempted use with this PTT, I found the better way. I built a small bracket out of aluminum and mounted the switch and bracket to a handy screw in the left-hand grip assembly on the handle bars. The switch is conveniently located right next to the horn button and can be easily actuated by the thumb on my left hand.

The last two items are the easiest. We have to have power for the rig, and we need a place for the antenna. If your motorcycle has a twelve volt battery, you have it made. Just run two wires from the battery to the rig. I would suggest running two wires rather than relying on the frame ground for your dc return. This keeps things nice and direct and avoids any intermittent ground problems cropping up later. Also check to make sure that your motorcycle electrical system ground is the same polarity as your rig. Motorcycles are not all standard twelve volt negative ground systems, and if this is different from your rig, you may pick up problems through the coax braid which will be grounded to the motorcycle chassis at the antenna mount.

The antenna mount I used was nothing more than some aluminum stock drilled and bent to mount on the rear fender attached to the rear tail light assembly. An

Antenna mounting bracket detail.

First try at going mobile — external speaker and hand-held microphone.

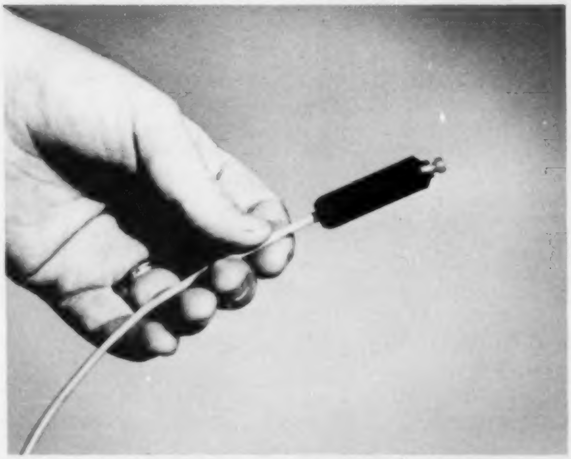
SO-239 chassis connector was mounted in the bracket. This way I can use either the traditional 1/4 wave whip in a PL-259 or the home brew 5/8 wave antenna which also ends in the same type connector. (See *73 Magazine*, "5/8 Wave Power for your HT," May, 1976, page 118.) If you then want to park the bike and not advertise the fact that you have a radio on board the antenna is easily removed. The battery wires and antenna coax are easily routed under the seat and gas tank and brought out from under the tank at some convenient spot. If you want to you can use tape or plastic cable ties to hold the wires in place as they go along the frame members. This will keep the wires off the hot engine and also keep them from getting pinched under the rubber supports of the seat and tank.

Now that you are ready to ride off in a cloud of dust, let me add a few words about operation of radios and motorcycle electrical systems. Most motorcycle electrical systems are marginal in capacity. You may find that you may have to be less long-winded than normal when operating motorcycle mobile to keep from running the battery down, depending, of course, on how much current your rig draws. I am currently using an HR 2 and have not had any problems keeping the battery charged due to the radio. However, my quartz headlight and extra marker lights in the fairing make me recharge the battery about every 3-4 weeks of constant use.

Also, a word about ignition noise. My Honda 550 four cylinder is very noisy electrically. Although it came with swamping resistors in the spark plug caps and I shielded the high voltage wires and coils, none of this had any effect on reducing the noise. I found out that Honda Fours have a very peculiar high voltage system. The ignition coil secondaries are not grounded on one side like they are in a car. They put two spark plugs in series with each other so the spark goes from the tip of one plug to ground, through ground to the other plug and then jumps to the tip of the second plug returning to the coil. So, the problem is that the engine case is a radiator rather than a shield for the spark. The only way I can see around this problem is to use four coils, one per plug, and ground one side of each secondary. Most of the time the ignition noise is down to a comfortable listening level as long as the repeater's signal strength is fairly high. However, when you're trying to receive weak signals the ignition noise can be fierce. Honda Twins (two cylinder engines) are not set up this way. They have a separate coil for each plug. If you experience problems, check your manual to see what kind of system you have. If it can be shielded, do it. Don't forget to add resistor caps and plugs along with any shielding you do, if the engine is not already equipped with them. After adding your improvements, you can use your rig or a transistor AM radio as an rf sniffer to check your thoroughness. Please take note: If your engine performance deteriorates after installing resistor caps or plugs, you may have to go back to the original equipment. Remember, motorcycle electrical systems are marginal. This includes the ignition system, too.

I have been operating motorcycle mobile for about eight months now with good success. Most stations I talk to can't tell the difference between me operating on the motorcycle and other people operating in cars. Frequently, surprised people ask me to repeat what I said when I sign with "Motorcycle Mobile." Then I am usually deluged with all sorts of questions about how other people can do it also.

Now you are ready to enjoy two loves at the same time, radio and motorcycling. I hope this will encourage you to take the plunge and become one of the few stations identifying with motorcycle mobile. ■



First external PTT switch. Hand-held, no bracket.

Inside the Bird

- - a wattmeter exposed

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Did you ever wonder how the Bird wattmeter does its thing? I did, after butting my head trying to get a Bendix directional coupler to operate at a power level far beyond its specs. So I started hunting for every piece of design information I could lay my hands on. I found out that the information was not only difficult to find, but also very sketchy when found.

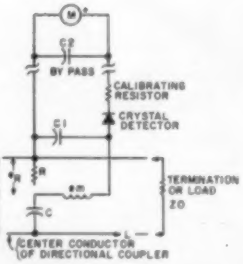

Fig. 1.

The Bird Model 43 wattmeter consists of three main sections: a directional coupler, a detector, and a calibrated readout. Let's start with the unit's readout, which is a very high quality 30 uA (microampere) meter. The meter face is kept simple by having only three basic scales: zero to 25, 50, and 100. The plug-in detectors of varied frequency and power ranges are all made in multiples and divisions of these scales. The meter incorporates about three feet of shielded cable and thus can be separated from the main frame for remote viewing.

The detectors are made to plug into the main frame or housing so that they couple to the center conductor of the directional coupler in a precise fashion for just the right amount of coupling for the specified power rating. The plug-in detectors have precision contacts that connect mechanically to the meter section. By rotating the detector 180° in its socket, one can take both a forward and reverse power reading. By applying the two readings into a simple formula, one derives vswr (the voltage standing wave ratio) on the transmission line:

$$\rho = \frac{1+\sqrt{\emptyset}}{1-\sqrt{\emptyset}} \text{ and } \emptyset = \left[\frac{\rho-1}{\rho+1}\right]^2$$

where ρ = vswr and $\emptyset = P_r/P_f$.

I knew that would scare some of you! But look at the formula again with an open mind this time, and see how really simple the formula is. Let's look at $\emptyset$. This is nothing more than the Greek letter "phi" that says the following relates to some voltage, magnetic flux, or angle relationship, and the symbol is easier to use than the equation it represents. In this case, $\emptyset$ or phi is equal to P_r/P_f. P_r is the reverse power reading and P_f is the forward reading. The forward reading is that which you get when the arrow on the detector plug is pointing in the direction of the antenna. And reverse power is that reading when you turn the plug 180° so that the arrow is pointing to the generator or source.

Now, with your calculator, take the forward reading, e.g., 50 Watts, and place it into the denominator (the divisor in the formula). Take the reverse reading, e.g., 5 Watts, and put it into the numerator. We now have $\emptyset$ = 5/50 or .1. Now let's take the rest of the formula or rho resistivity:

$$\rho = \frac{1+\sqrt{.1}}{1-\sqrt{.1}}$$

Take your calculator again and find that $\sqrt{.1}$ = .32. If you can't believe that, multiply .32 by itself and find that it equals .1. ρ=1+.32/1-.32 or 1.32/.68, which equals 1.94, which is the vswr, 1.94 to 1 or roughly 2/1.

Now that you are convinced that you can easily find vswr by measuring two powers, it's even easier to just refer to the curves furnished with the instrument. Then there are no mathematical calculations whatever. But now you know. Let's go on. The detector probe couples to a 50 Ohm cavity, the dimensions of which have been calculated by the relationships of the outside diameter of the center conductor to the inside diameter of the cavity, e.g., $Z = 138 \log (d_1/d_2)$. The formula is more involved where the dielectric is other than air.

The cavity in this case is a thruline lumped constant directional coupler; the detector probe or sensor extracts a sample of rf energy from the line in either a forward or reflected direction. Fig. 1 is a representation of the sensor makeup. It can be likened to an AM detector receiving a CW signal. The signal is rectified and the dc actuates the meter readout.

Basically, the sensor is comprised of a resistor R and a loop of wire which couples to the cavity conductor by mutual inductance M. When the plug faces the forward direction, M is positive. Rotating the plug 180°, M becomes negative.

The capacity between the junction of the resistor R and loop M and the center conductor of the line section makes up the capacity component C. The loop, being a small fraction of a wavelength, will discriminate between the forward and reflected waves.

Looking again at Fig. 1, C and R make up a voltage dividing network. M is the mutual inductance between the loop and the line section center conductor. E is the voltage between the center and outer conductors of the line section. I is the current in the line.

The voltage and power sensitivity are proportional to the distance between the coupling loop and the line section center conductor. Now, looking at the transmission line, the voltage "E" at any point on this line is equal to the sum of the (f) forward and (r) reflected voltage, $E_f + E_r$, and the current "I" is $(E_f/Z_o)-(E_r/Z_o)$. Since the reflected wave travels in the opposite direction, $I_r = E_r/Z_o$,

$$e_{\rightarrow} = j\omega M \left(\frac{E}{Z_o} + I\right)$$

$$= j\omega M \left\{\frac{E_f + E_r}{Z_o} + \frac{E_f - E_r}{Z_o}\right\}$$

$$= \frac{j\omega M}{Z_o} \quad (2\,E_f)$$

and turning the element toward the source, it becomes:

$$e_{\leftarrow} = j\omega M \left(\frac{E}{Z_o} - I\right)$$

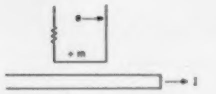

Fig. 2. Element in forward direction.

$$= j\omega M \left\{\frac{E_f + E_r}{Z_o} - \frac{E_f - E_r}{Z_o}\right\}$$

$$= \frac{j\omega M}{Z_o} \quad (2\,E_r)$$

The "j" term simply means that the pickup voltage and current is 90 degrees out of phase with the line voltage and current.

The two formulas show that the rf output voltage from the sensing element is directional and proportional to the voltage in the line due to either the forward or reflected wave. It is also directly proportional to $\omega = 2\pi f$. In order to make it frequency independent, we terminate e in a capacitive reactance which is inversely proportional to ω. The voltage across this capacitor is rectified, filtered, and displayed on the meter scale, calibrated in Watts.

Previously, we stated that E at any point on a line is equal to the sum of the forward and reflected voltage on a flat line (one terminated into its characteristic impedance or one with unity standing wave ratio). The voltage at any point on this line will be equal, as there is no reflected wave ($E = e_f + e_r$). This makes sense as the line is a flat 50 Ohms at any point along its length. If this is so, then the current will also remain constant. From this, the power at any point is equal to $I^2R = IXE$.

However, the line is not always terminated into its characteristic impedance, as some of us well know by past experience. This tells us that on such an improperly terminated line, not only E but also I will vary. Because the wattmeter sensing element's loop M length is a small fraction of a wavelength, we can sample the vswr at any point on the line; both forward and

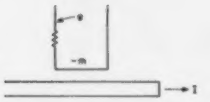

Fig. 3. Element in reverse direction.

reverse current are sampled at the same point and $E = e_f + e_r$. Have I convinced you? I can hear the opposition already.

True, some of you have made measurements on UHF and in essence can show that I and E did not remain constant on your supposedly properly terminated line. I hope you did not use 80' to 100' of RG-58/U. There is a logical explanation for this. At the higher frequencies, it is necessary to use low loss line. If not, the losses in the line will produce data that can give you the impression that you have a well-matched load at the antenna end. 100' of RG-58/U has approximately 3 dB of loss at 150 MHz. Only ½ the power gets up to the antenna, and if the antenna does not look like the feedline, what is reflected is attenuated by 3 dB on the way back. By the time it gets to the source and to the point where you are making the measurement, everything looks rosy. In this case, you might take a second measurement at the antenna end (between the feedline and the antenna). The difference between the power measured at the source and at the load will tell you the loss of power in the line.

Sometimes it is easier to find lower loss 70Ω coax than the comparable 50Ω line. I use CATV semi-rigid and rigid 70Ω line which has a fraction of the loss of RG-8/U at UHF. Before concluding, there is another point of interest to many using a 50Ω Bird and 70Ω or 90Ω coaxial lines. With certain limitations, good results may be obtained on 70 Ohm coaxial cable with a 50 Ohm wattmeter. The insertion of a Bird Mod 43 thruline wattmeter in a line adds 4 inches of 50 Ohm air line plus connectors into the system. This will change the load on the transmitter from its original condition without the meter.

Even on 50 Ohm systems above 100 MHz where the vswr is above 1.5, removing the wattmeter will cause a change. This is so because changing the length of line between a mismatched load and the source transforms the impedance of the load as seen at the source. If the adjustments for maximum energy transfer were made with a feedthru wattmeter in place, removing the meter afterwards will change the conditions. However, conditions on a line repeat themselves every ½ wavelength. The conditions on the line with the wattmeter inserted can be duplicated when the meter is removed by inserting an additional length of coax along with the meter, the total length of 50Ω coax and wattmeter equaling ½ wavelength. Be sure to take the velocity factor (dielectric constant) of the coax and connectors into consideration, removing both meter and added line section as one unit after all adjustments have been completed.

Another interesting method which I use (fully described by WB4KSS in the May, 1975, issue of *Ham Radio*, entitled, "Measuring Complex Impedance with an SWR Bridge") utilizes a double data system of measurements and a computer set of readouts made from a series of Smith chart plots. This method is especially good when using a 50Ω bridge and transmission lines of higher impedance.

Many hams now possess the treasured 50Ω wattmeter. With a little understanding of its abdominal functions, you should be able to find more uses for it than just measuring the output power of your transmitter. More power to you! ■

References

Watts News from Bird — Vol. 1, No. 2, Jan., 1964; Vol. 2, No. 2, Mar.-Apr., 1965; Vol. 4, No. 1, Jan.-Feb., 1967.

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Introducing Autotrak!

-- digital antenna tracking system

It has been a long time (over two years) since the big winter wind (I swear it was Murphy's big mouth) took down our first EME array attempt. The horizontal boom (40' tower) was too weak, the drive system left a lot to be desired in the elevation mode and was not too great in azimuth mode either, and so on. Oh well, live and learn.

In this article I hope to point out some of the corrections for any of you enterprising large array freaks like me, and also explain the most advanced – and in the future useful – piece of electronics added while we were down and muttering through the chill of two winters.

The electronics improvement I'm referring to is the Autotrak. If you are not interested in the EME work, don't stop reading now. How about all of you OSCAR fans? Want to track that little devil automatically so you can concentrate on making contacts and not have to grow six hands? Read on. Also, how about you die-hard contest ops? This unit will swing the beam around to precise headings on any preset timetable, and you choose the timetable!

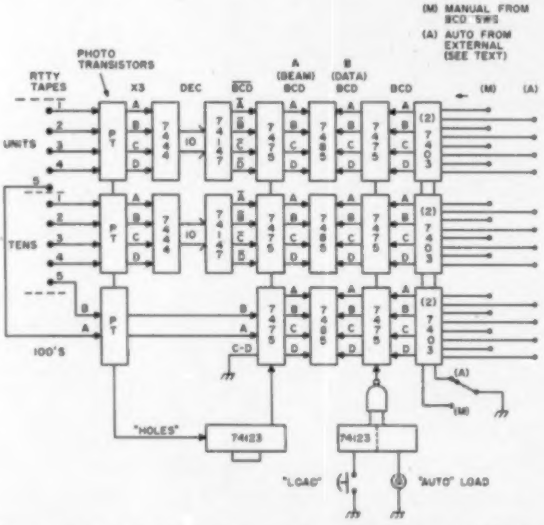

Fig. 1. Autotrak block diagram shown for azimuth (3 digits). Delete 100s for elevation. Elevation note: 5th line holes used for determining north or south quadrants in elevation (- or +). See schematic for details.

The antenna array here is an el-az type driven in elevation and azimuth, not a polar mount. This makes it a little tougher to track celestial objects (i.e., the moon), but it is much easier for satellites, tropo, etc. To give you some idea of our setup, there are sixteen 11 element Cushcraft modified 147-11 yagis mounted for horizontal polarization, approximately 1 wavelength apart from each other in both horizontal and vertical dimensions. This gives an overall array size of approximately 36' wide (tower), 20' top to bottom (vertical masts), and 12' deep (antenna booms). Big, in other words! This leads to special problems, but none that can't be overcome with a machine shop, super mechanical ability, or a Jeep engine for a rotor. The azimuth drive is handled by the old-time ham's workhorse – the prop-pitch motor ($3.00 at hamfest), the transformer for its power ($1.00 as a military surplus battery charger transformer – tapped input, tapped output, 20 Amps – hamfest), shaft coupler to absorb shaft misalignment (3/4" plywood doughnut and 1" x 3/16" flat steel – big oversize flexible coupler – hardware store parts), 4 heavy duty wheels for a lazy Susan type arrangement on top that allows rotary motion in azimuth (scrapped off factory package cart with 3' x 5' bed, 4" wheels with roller bearings, super heavy duty, and free), constructed wooden "doghouse" that tower lays in on 4 more of the cart wheels (plywood, well varnished and painted – wood *can* survive outdoors if you do it right). So much for azimuth.

Elevation is accomplished by building up a triangular tower (ours is Spaulding HDX) so it is circular in two places (more 3/4" plywood, double thickness) and putting 1" x 3/16" strap steel around it to form 2 metal rim "wheels" spaced just barely wider than the doghouse width. More package cart wheels are used as "bearings" (4), and the tower rotates along its own centerline. Therefore, anything attached to vertical booms running 10' above and 10' below the tower horizontal centerline remains in balance as the whole tower is rotated. This means you only have to overcome the metal rim "wheels" to package cart "bearings" friction. To do this and get the kind of resolution you need, use a pair of RCA through type rotors mounted horizontally to the back floor of the doghouse with a 1¼" o.d. waterpipe between them and through both. This becomes the drive "drum" for aircraft cable drive that push-pull drives a drum built around the center of the tower in the doghouse. This drum is constructed much like the tower metal rim "wheels." Two wooden discs form the outside edges and cable "guides," and ¼" x 20 3" long bolts are passed between them from alternate sides every 2" on a diameter that just touches the three tower legs. The wooden guide edges are made 1" larger than the bolt circle to hold the cables on the bolt circle. The bolts themselves are covered by another piece of 1" x 3/16" strap steel formed into a drum over the bolts. Cables are fed 1 turn around the drum and then to the pipe drive drum. One cable goes one direction around the drum and the same way around the drive drum (pipe). The other cable goes the opposite way, for a push-pull action. Sufficient cable turns are placed around the drive drum to allow the tower to turn through a full 180°, or full front over top to full rear. This allows full 360° azimuth and 180° elevation coverage, but only requires the actual azimuth to turn 180°, east through south to west. West through north to east is taken care of by bringing the elevation up from 0° through 90° and on over into the north quadrants. Some may question the inverted horizontal polarization. One, we don't see any difference at all in the tests we ran. Two, very little work will be done in the north quadrants anyway except for initial North Star sighting and original bearing calibration.

This has been a rough detail of what we run, and an article will follow describing things in detail with (hopefully) many pictures, but you can see the problems with steering and tracking such a large array with such narrow beamwidths, both horizontal and vertical. You can't imagine how small that moon can be until you go looking on a cloudy night when visual tracking is out.

This brings us to our answer to steering this whole beast. The electronic tracking control is all TTL IC type quite common nowadays, and cheap! First, I'll try to describe it in function and peripheral equipment, and then by circuits.

In general, from the antenna end, two paper or mylar RTTY type "tapes" mount to a round clear plastic cake pan that is mounted to the azimuth shaft. These tapes are easily done by yourself or a fellow amateur with RTTY gear. They are punched using the Baudot holes, but the code is *not* Baudot. It requires all 5 holes for one number in Baudot, or 15 holes (three tapes) for the azimuth readings. I devised a "fake" code table that will allow you to punch the two tapes using the letters common on the "green keys," but the holes that result are later read as follows. One tape (top in our case) is called units and represents the ones of degrees on lines one to four. The hole code if you read it as line 1 = A, line 2 = B, line 3 = C, and line 4 = D, is really Excess 3 gray code. The advantage is that as each number changes up or down a degree at a time, only one A, B, C, or D line changes, unlike BCD or binary where many often do (i.e., in BCD 7 to 8 transition, all four change!). This helps in error reading reduction, settling time, etc., and much more than we can go into here. It works much better, ok?

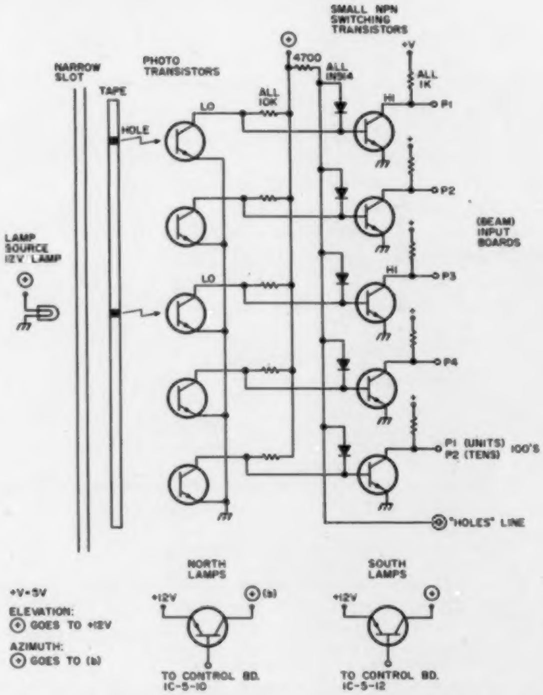
SMALL NPN SWITCHING TRANSISTORS
NARROW SLOT
PHOTO TRANSISTORS
TAPE
HOLE
LO
ALL 10K
4700
ALL IN914
+V
ALL 1K
HI
P1
P2
P3
P4
P1 (UNITS) P2 (TENS) 100'S
(BEAM) INPUT BOARDS
LAMP SOURCE 12V LAMP
"HOLES" LINE
NORTH LAMPS
SOUTH LAMPS
+V=5V
ELEVATION: GOES TO +12V
AZIMUTH: GOES TO (b)
+12V
(b)
TO CONTROL BD. IC-5-10
TO CONTROL BD. IC-5-12

Fig. 2. Lamps and photo transistor "readers," 6 for full system: 2 elevation, 2 north quadrant az, 2 south quadrant az.

These tapes are fastened to the clear cake pan rim or side walls and are read by a lamp source on the inside and a phototransistor type pickup outside (5 per tape, see detail).

The second tape is called a tens tape and lines one to four carry the 10s of degrees in Excess 3 gray code much like the units tape, but the preparation or encoding is *quite* different. We manage to "fake" the two tapes into taking care of the three digits

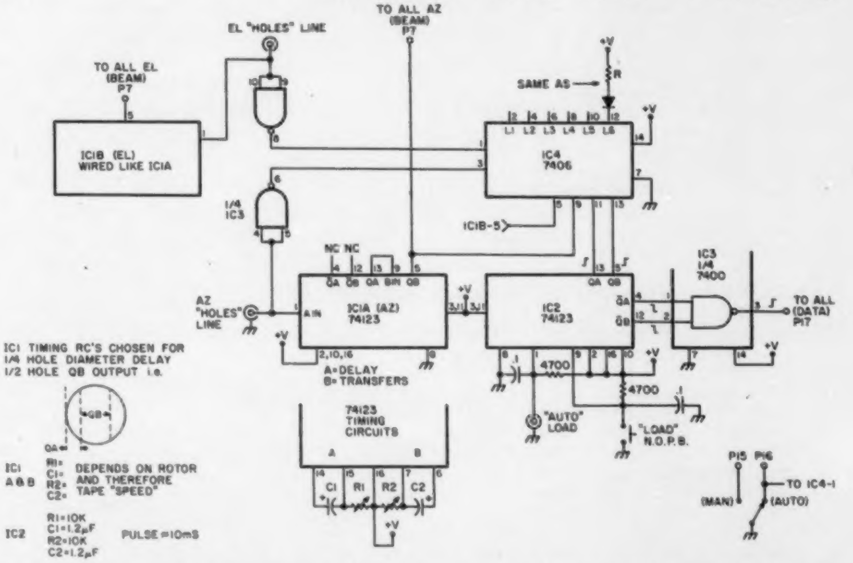
EL "HOLES" LINE
TO ALL AZ (BEAM) P7
TO ALL EL (BEAM) P7
IC1B (EL) WIRED LIKE IC1A
SAME AS
R
+V
L1 L2 L3 L4 L5 L6
IC4 7406
1/4 IC3
IC1B-5
NC NC
AZ "HOLES" LINE
IC1A (AZ) 74123
A=DELAY
B=TRANSFERS
IC2 74123
IC3 1/4 7400
TO ALL (DATA) P17
4700
"AUTO" LOAD
"LOAD" N.O.P.B.
IC1 TIMING RC'S CHOSEN FOR 1/4 HOLE DIAMETER DELAY 1/2 HOLE QB OUTPUT i.e.
QA
QB
IC1 A & B R1= C1= R2= C2= DEPENDS ON ROTOR AND THEREFORE TAPE "SPEED"
IC2 R1=10K C1=1.2µF R2=10K C2=1.2µF PULSE=10mS
74123 TIMING CIRCUITS
A
B
C1 R1 R2 C2
P15 P16
TO IC4-1
(MAN)
(AUTO)

Fig. 3. Control and status board and front panel, part 1. L1 — holes detected, el; L2 — holes detected, az; L3 — beam input transfer, el; L4 — beam input transfer, az; L5 — auto-load; L6 — load. R to suit LED I limits (<40 mA).

by using the fifth line of the Baudot tapes to carry the 0-1-2-3 figures of 100s of degrees.

This is done as follows: On degrees 000 to 099, the Baudot letter is used that cuts the proper gray code on tape one and proper gray code on tape two on lines 1 to 4 respectively, and yet does not punch a hole on line 5 of either tape. Or, line 5 of each tape is a blank (no hole) (0,0), or B = 0, A = 0, decimal zero.

On degrees 100 to 199, the Baudot letter is chosen on the units tape that causes the proper gray code for units, but adds a hole in the fifth line. The tens tape is punched using the same letter system of 000 to 099 degrees using no line 5 hole. Or, line 5 on tape units is a hole, and tape two tens is blank (no hole) (0,1), or B = 0, A = 1, a decimal one (C and D are understood zero and are not needed to represent any number from zero to four).

Azimuth Units Tape
Key Sequence — Insert no extra keys, spaces, or blanks.

#

1. (001 to 010 degrees) Type the sequence:
   I U S SPACE N F K C R LINE FEED
2. (011 to 090 degrees) Repeat sequence 1 eight times:
3. (091 to 100 degrees) Type the sequence:
   I U S SPACE N F K C R L
4. (101 to 110 degrees) Type the sequence:
   P Q Y H M X LTRS V G L
5. (111 to 190 degrees) Repeat sequence 4 eight times:
6. (191 to 200 degrees) Type the sequence:
   P Q Y H M X LTRS V G LF
7. (201 to 210 degrees) Type the sequence:
   I U S SPACE N F K C R LF
8. (211 to 290 degrees) Repeat sequence 7 eight times:
9. (291 to 300 degrees) Type the sequence:
   I U S SPACE N F K C R L
10. (301 to 310 degrees) Type the sequence:
    P Q Y H M X LTRS V G L
11. (311 to 360 degrees) Repeat sequence 10 five times:

Azimuth Tens Tape

12. (001 to 009 degrees) Type: LINE FEED (9 times)
13. (010 to 019 degrees) Type: I (10 times)
14. (020 to 029 degrees) Type: U (10 times)
15. (030 to 039 degrees) Type: S (10 times)
16. (040 to 049 degrees) Type: SPACE (10 times)
17. (050 to 059 degrees) Type: N (10 times)
18. (060 to 069 degrees) Type: F (10 times)
19. (070 to 079 degrees) Type: K (10 times)
20. (080 to 089 degrees) Type: C (10 times)
21. (090 to 099 degrees) Type: R (10 times)
22. (100 to 109 degrees) Type: LINE FEED (10 times)
23. (110 to 119 degrees) Repeat #13
24. (120 to 129 degrees) Repeat #14
25. (130 to 139 degrees) Repeat #15
26. (140 to 149 degrees) Repeat #16
27. (150 to 159 degrees) Repeat #17
28. (160 to 169 degrees) Repeat #18
29. (170 to 179 degrees) Repeat #19
30. (180 to 189 degrees) Repeat #20
31. (190 to 199 degrees) Repeat #21
32. (200 to 209 degrees) Type: L (10 times)
33. (210 to 219 degrees) Type: P (10 times)
34. (220 to 229 degrees) Type: Q (10 times)
35. (230 to 239 degrees) Type: Y (10 times)
36. (240 to 249 degrees) Type: H (10 times)
37. (250 to 259 degrees) Type: M (10 times)
38. (260 to 269 degrees) Type: X (10 times)
39. (270 to 279 degrees) Type: LTRS (10 times)
40. (280 to 289 degrees) Type: V (10 times)
41. (290 to 299 degrees) Type: G (10 times)
42. (300 to 309 degrees) Repeat #32
43. (310 to 319 degrees) Repeat #33
44. (320 to 329 degrees) Repeat #34
45. (330 to 339 degrees) Repeat #35
46. (340 to 349 degrees) Repeat #36
47. (350 to 359 degrees) Repeat #37
48. (360 degrees) Type X (one time)

Table 1.

On degrees 200 to 299, the fifth line hole combination reverses (1,0), or B = 1, A = 0, a decimal two.

On degrees 300 to 360 (399 possible numbers, but only 360 degrees), both tapes have the fifth line hole (1,1), or B = 1, A = 1, a decimal three.

You may now have noted the output from the fifth lines are the 100s information in direct BCD code. It seems to be OK here since the transitions only occur infrequently and at three places in the entire 360 degrees (099 to 100, etc.).

To use the gray codes from the 1s and 10s, you must convert it to BCD for use in TTL comparators. I use SN7444 gray code to decimal ICs to do this, then use SN74147 ICs to go from decimal to $\overline{\text{BCD}}$. This $\overline{\text{BCD}}$ is fed to the inverted arrangement shown in the SN7475 latches, and when the transfer line goes high, it is transferred to the A0 to A3 inputs of the 7485 comparators as BCD, right side up. More on the transfer lines later. The 100s of azimuth are fed directly to the 7475s, then 7485s. All azimuth 7475 transfer lines are tied together.

From the data input end, let's cover the manual mode first. This is a mode where you can enter a "go to" degrees command via a set of 5 thumbwheel BCD output switches like many synthesized 2m rigs now have. The outputs of the first three switches (azimuth) are gated through manual/automatic gates to 7475 latches. The transfer lines of these latches are fed from one half of a dual one-shot 74123. That half is fed by a panel pushbutton marked "load." To use this mode, information is put into the switch in decimal form the way you think for 100s, 10s, and 1s of degrees, the manual/automatic (man/auto) is placed in manual, and the "load" switch is momentarily depressed. The one-shot puts a nice clean high pulse on the transfer lines, and the gate information fed into the manual (M) gates is transferred to the 7475s and held there. That's all there is to it.

A brief word of explanation is in order here. Since all of our towerhouse gear is remote controlled by wire from my basement, the only time the system does not then go immediately into search or motion automatically is when the power off switch is placed to off. *Any* other time the antenna position information (BEAM) does not agree with the output information from the man/auto side 7475s

Elevation Units Tape

#

1. (001 to 090) Same as azimuth units 001 to 090.
2. (-089 to -080) Type the sequence:
   G V LTRS X M H Y Q P L
3. (-079 to -010) Repeat sequence 2 seven times:
4. (-009 to -001) Type the sequence:
   G V LTRS X M H Y Q P

Elevation Tens Tape

5. (001 to 090) Same as azimuth units 001 to 090.
6. (-089 to -080) Type: V (10 times)
7. (-079 to -070) Type: LTRS (10 times)
8. (-069 to -060) Type: X (10 times)
9. (-059 to -050) Type: M (10 times)
10. (-049 to -040) Type: H (10 times)
11. (-039 to -030) Type: Y (10 times)
12. (-029 to -020) Type: Q (10 times)
13. (-019 to -010) Type: P (10 times)
14. (-010 to -001) Type: L (9 times)

Table 2.

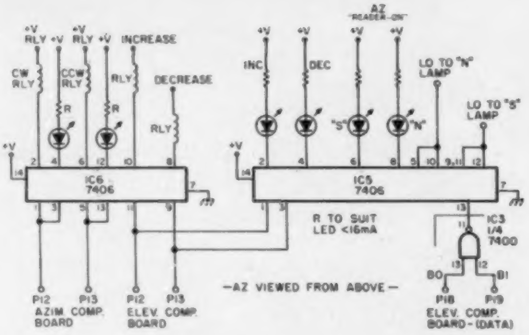
+V RLY
+V
+V RLY
+V
INCREASE
CW RLY
CCW RLY
RLY
DECREASE
R
R
RLY
+V
IC6 7406
AZ "READER-ON"
+V
INC
DEC
"S"
"N"
LO TO "N" LAMP
LO TO "S" LAMP
IC5 7406
R TO SUIT LED <16mA
IC3 1/4 7400
B0
B1
-AZ VIEWED FROM ABOVE-
P12 P13 AZIM COMP. BOARD
P12 P13 ELEV. COMP. BOARD
P18 P19 ELEV. COMP. BOARD-(DATA)

Fig. 4. Control, part 2, full system.

(DATA), the antennas move to correct this. Thus if for any reason (wind, etc.) the antennas move away by themselves, they are automatically correct as soon as the gray code error is noted – assuming the power is on. This neat feature has many side benefits. For instance, if you look back to the Nov., 1976, *73 Magazine*, page 84, article by me, you will see a wind indicator device whose output is in degrees and BCD code. That device was no accident, and if fed into the automatic inputs of this control unit, and the unit left in automatic mode and on, the beams will always face into the wind! In some parts of this country, that almost makes these two projects worthwhile on that reasoning alone. Our tower horizontal section is braced, etc., such that our best way is facing into the wind. I would advise, however, you only sample and compare 100s and 10s of degrees to keep the array from forever "hunting" and burning out motors, etc.

In the automatic mode, information (DATA) from the automatic mode gates (A) is routed to the data 7475s. It is transferred only when the transfer line is brought high. This is accomplished in the auto mode by any TTL level low applied to the auto-load input connector.

I failed to mention the single gate that allows tying both outputs of the 74123 to the latch line. I'm sure you are all doing your *73* reading and I/O homework, but since it is an inverted use of a NAND gate 7400, I'll explain. The inputs to either 74123 are low going transitions. This creates a pulse output determined by the RC chosen for each one-shot. You then use the normally high output of each 74123 to feed the 7400 inputs. Normal condition is (with no inputs) both 7400 inputs high, output or transfer line low, no transfer. If either input sees a low transition, the one-shot goes low, the 7400 output goes high, and transfer occurs.

Skipping where the automatic input (DATA) comes from for a minute, the auto transfer input in our case has several possibilities. Of course the "load" push-button is one of them, even if the man/auto switch is in auto. Another is an S.D. Sales 60 Hz timebase driving one of our older TTL

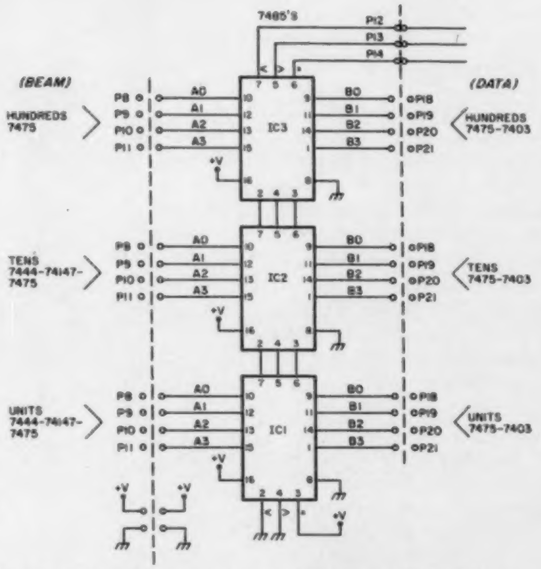
7485'S
P12
P13
P14
(BEAM)
(DATA)
HUNDREDS 7475
TENS 7444-74147-7475
UNITS 7444-74147-7475
P8
P9
P10
P11
A0
A1
A2
A3
IC3
IC2
IC1
B0
B1
B2
B3
P18
P19
P20
P21
HUNDREDS 7475-7403
TENS 7475-7403
UNITS 7475-7403
+V

Fig. 5. Azimuth comparator module. Note: Elevation – same board; see "Comparator Operation – Elevation."

real time clocks, and the 1 ppm, 1p/2m, etc., lines brought out through a rotary switch (you obviously want new data faster, more often, on OSCAR than with EME) and a BNC jack over to the beam control (Autotrak) unit, which incidentally will be all buttoned up in a Drake TR-6 case when finished to match the rest of the console, to give you some idea of size. Another source for use on schedules, and for our eventual use remote from Indy stations and members of ECHO, is a set of 7485 comparators added to the old clock and four more BCD switches. You dial in a time in hours and minutes (4 digits – GMT) and at the appointed hour it turns on many things in the station via the A = B output (high) to the 6 inputs of a hex inverter/line driver IC whose outputs (low) do the controlling. One of these lines (low) turns on the antenna control, another "hits" the transfer line indirectly. Since these outputs are there for the full minute

1 = M = Hole **Track 1 = A, 2 = B, 3 = C, 4 = D.**

	X3 Gray Code				Baudot Track					RTTY
	D	C	B	A	4	3	2	1	5	Letter
0	0	0	1	0	0	0	1	0	0	LINE FEED
					0	0	1	0	1	L
1	0	1	1	0	0	1	1	0	0	I
					0	1	1	0	1	P
2	0	1	1	1	0	1	1	1	0	U
					0	1	1	1	1	Q
3	0	1	0	1	0	1	0	1	0	$
					0	1	0	1	1	Y
4	0	1	0	0	0	1	0	0	0	SPACE
					0	1	0	0	1	H
5	1	1	0	0	1	1	0	0	0	N
					1	1	0	0	1	M
6	1	1	0	1	1	1	0	1	0	F
					1	1	0	1	1	X
7	1	1	1	1	1	1	1	1	0	K
					1	1	1	1	1	LTRS
8	1	1	1	0	1	1	1	0	0	C
					1	1	1	0	1	V
9	1	0	1	0	1	0	1	0	0	R
					1	0	1	0	1	G

Table 3. Baudot to X3 Gray Table.

the clock and switches agree, plenty of time is allowed for a positive control. A tape in our case (RTTY) is loaded into the tape reader and set on the first set of holes representing the 100s of degrees of azimuth. For your own information and for future articles, all of our data information will be in azimuth-elevation, 100s, 10s, 1s, 10s, 1s format, i.e., 10545 is 105 degrees azimuth and 45 degrees elevation.

A decoder for Baudot (numbers only) to BCD accepts the tape information in parallel from the reader, using the stop pulse to transfer to the next memory latch (digit). 7475s are used here also, but the data control unit is the subject of the next article, so more on it there. The control mode is as follows, however: (1) it is time to read tape – 1 ppm from clock, etc.; (2) This pulse turns on the tape reader FF and therefore the tape reader; (3) As long as there is tape in, reader tape advances, putting info into the latches; (4) When the fifth digit is loaded (az-el), a pulse is formed in the data control unit, resetting the tape reader FF, shutting off the tape reader, and the same pulse "hits" the (DATA) side 7475 transfer lines; (5) 7485s compare data and run beams to new headings as required.

You will no doubt realize, too, that a UART having ASCII output has lines 1 to 4 already in BCD code for numbers. You can now detect the serial stop pulse to advance the memory latches and have a keyboard input. Baudot owners can run in the FIGS mode into our control unit and do the same thing. You may recall my rotary dial decoder also in the Nov., 1976, 73 *Magazine*, and it is mentioned in there the control device used here as a data control unit. It works very similarly to the dial decoder, since one was an outgrowth of the other.

Due to their general lack of use until recently in amateur

Table 4.

AZ	AZ		EL		EL
Degrees	**Units 5th**	**Tens 5th**	**Units 5th**	**Tens 5th**	**Degrees**
001	I	LF	SAME AS AZ TAPE	SAME AS AZ TAPE	SAME AS AZ TAPE
002	U	LF			
003	S	LF			
004	SP	LF			
005	N	LF			
006	F	LF			
007	K	LF			
008	C	LF			
009	R	LF			
010	LF	I			
011	I	I			
012	U	I			
013	S	I			
014	SP	I			
015	N	I			
016	F	I			
017	K	I			
018	C	I			
019	R	I			
020	LF	U			
021-029	RPT I TO R SEQ.	U			
030	LF	S			
031-039	RPT I TO R SEQ.	S			
040	LF	SPACE			
041-049	RPT I TO R SEQ.	SPACE			
050	LF	N			
051-059	RPT I TO R SEQ.	N			
060	LF	F			060
061-069	RPT I TO R SEQ.	F			061-069
070	LF	K			070
071-079	RPT I TO R SEQ.	K			071-079
080	LF	C			080
081-089	RPT I TO R SEQ.	C			081-089
090	LF	R	LF	R	090
091	I	R	5thG	5th V	MINUS 89
092	U	R	V	V	MINUS 88
093	S	R	LTR	V	MINUS 87
094	SP	R	X	V	MINUS 86
095	N	R	M	V	MINUS 85
096	F	R	H	V	MINUS 84
097	K	R	Y	V	MINUS 83
098	C	R	Q	V	MINUS 82
099	R	R	P	V	MINUS 81
	5th HOLE	5th			
100	L	LF	L	V	-80
101	P	LF	G	LTR	-79
102	Q	LF	V	LTR	-78
103	Y	LF	LTR	LFT	-77
104	H	LF	X	LTR	-76
105	M	LF	M	LTR	-75
106	X	LF	H	LTR	-74
107	LTRS	LF	Y	LTR	-73
108	V	LF	Q	LTR	-72
109	G	LF	P	LTR	-71
110	L	I	L	LTR	070
111-119	RPT P TO G SEQ.	I	RPT G TO P SEQ.	X	069-061
120	L	U	L	X	060
121-129	RPT P TO G SEQ.	U	RPT G TO P SEQ.	M	059-051
130	L	S	L	M	050
131-139	RPT P TO G SEQ.	S	RPT G TO P SEQ.	H	049-041
140	L	SP	L	H	040
141-149	RPT P TO G SEQ.	SP	RPT G TO P SEQ.	Y	039-031
150	L	N	L	Y	030
151-159	RPT P TO G SEQ.	N	RPT G TO P SEQ.	Q	029-021
160	L	F	L	Q	020
161-169	RPT P TO G SEQ.	F	RPT G TO P SEQ.	P	019-011
170	L	K	L	P	010
171-179	RPT P TO G SEQ.	K	G	L	009
180	L	C	V	L	008
181-189	RPT P TO G SEQ.	C	LTR	L	007
190	L	R	X	L	006
191	P	R	M	L	005

192	Q	R
193	Y	R
194	H	R
195	M	R
196	X	R
197	LTRS	R
198	V	R
199	G	R
200	LF	L
201	I	L
202	U	L
203	$	L
204	SP	L
205	N	L
206	F	L
207	K	L
208	C	L
209	R	L
210	LF	P
211-219	RPT I TO R SEQ.	P
220	LF	Q
221-229	RPT I TO R SEQ.	Q
230	LF	Y
231-239	RPT I TO R SEQ.	Y
240	LF	H
241-249	RPT I TO R SEQ.	H
250	LF	M
251-259	RPT I TO R SEQ.	M
260	LF	X
261-269	RPT I TO R SEQ.	X
270	LF	LTR
271-279	RPT I TO R SEQ.	LTR
280	LF	V
281-289	RPT I TO R SEQ.	V
290	LF	G
291	I	G
292	U	G
293	S	G
294	SP	G
295	N	G
296	F	G
297	K	G
298	C	G
299	R	G
	5th	5th
300	L	L
301	P	L
302	Q	L
303	Y	L
304	H	L
305	M	L
306	X	L
307	LTR	L
308	V	L
309	G	L
310	L	P
311-319	RPT P TO G SEQ.	P
320	L	Q
321-329	RPT P TO G SEQ.	Q
330	L	Y
331-339	RPT P TO G SEQ.	Y
340	L	H
341-349	RPT P TO G SEQ.	H
350	L	M
351	P	M
352	Q	M
353	Y	M
354	H	M
355	M	M
356	X	M
357	LTR	M
358	V	M
359	G	M
360	L	X

END OF AZ TAPES

5th = no 5th hole.

H	L	004
Y	L	003
Q	L	002
P	L	001

END OF EL TAPES

gear, the 7485 may seem a bit strange to you. The cascade inputs on these devices work great, but be careful to hook up as shown with the LSB digit getting the hardwired inputs, and the outputs coming from the MSB digit (azimuth 100s, elevation 10s). Reverse it and you are in for some real surprises. When you are working the underside of a board, it is easy to transpose LSB and MSB digit. Please don't ask me how I know this so well — nobody's perfect!

The elevation works just the same way as azimuth with one less number to worry about. We use linear tapes punched the same as for azimuth; it's just easy to get them in the doghouse that way rather than around a drum. Same data table applies. The same decoding, comparing, data in, all works the same.

For those of you who have counter (digital counting, readout type) dials on your receivers now or are planning it, consider our much modified BC 348s for a minute. If we use a dc drive (sawtooth waveform) to control the varactor group to "scan" the receiver, something very similar to this article has proven very useful and will be an upcoming article when we get back to the Space Age Junque series. Meanwhile, I'll let you brave ones ponder it on your own.

One: thumbwheel switches for a BCD frequency input. Push the auto scan button and an FF starts the scan. The final 7485 comparator A = B output stops the scan at the desired dialed-in frequency.

Our system does not really use sawtooth scan, though it looks like it does. When the auto scan button is pushed

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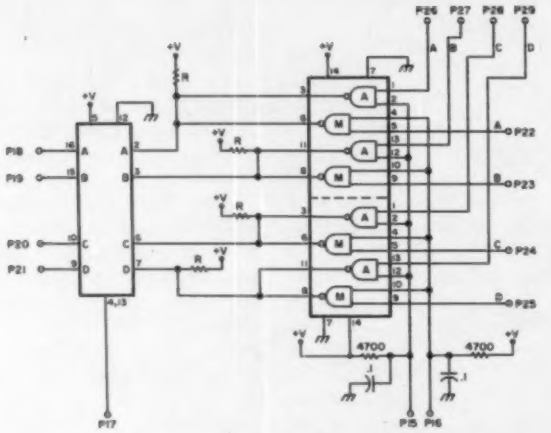

Fig. 6. Data input boards, 5 required. R = 1k.

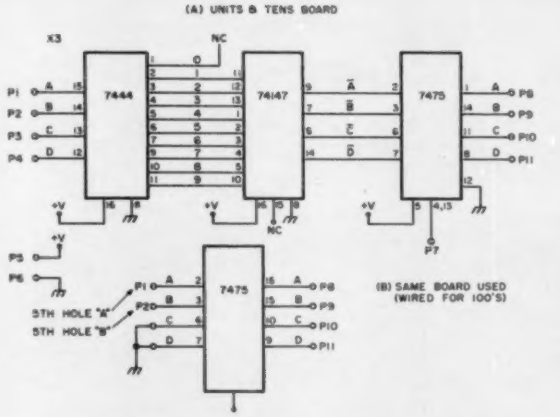

Fig. 7. Beam input boards. 4 wired (a) Az – 10s, 1s; El – 10s, 1s. 1 wired (b) Az – 100s.)s.

(or is called up remotely from Indy), the FF for this starts the scan by turning on the "charge" switch (transistor) of a dc memory module similar to the RCA remote control memory modules of a couple of years ago. The memory output is 1 to 10 V dc and controls the frequency varactors. There *is* a counter on the BC 348 for a dial readout (348 rack mount, readout, control, master oscillator, etc., console mounted), and the counter begins to follow the frequency upward. Upper limit is a set of jumpers to hardwire upper and lower limit gates. A stop command, AFC zero crossing plus AGC (station heard), or output from counter = limit switches comparison in 7485s, will stop the up scan. In the first two cases it is stop and hold, and in the latter it tells the scan FF to reverse. The "discharge" switch in the dc memory module takes over and causes a downward scan with the same features. Keying of the transmitter will generate a stop command and hold followed by a one-shot delay in resuming after carrier drop (sense COR on incoming remote link receiver).

One more? OK, last one for now. Consider we have a receiver with a counter dial. Doesn't take much to have a receiver with digital AFC, does it? You can ponder that one awhile – it takes one more IC!

SASE if you have problems. This should reduce the Bufferin sales to OSCAR users. ■

Stuart W. Hawkinson
6106 Lillywood Lane
Knoxville TN 37921

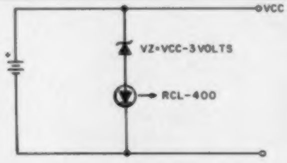

Fig. 1.

A Battery Voltage Monitor

-- how simple can an IC project get?

A device introduced by Litronix, Inc., has wide application as a voltage monitor in all types of battery-operated equipment. The RCL-400 Battery Status Indicator is a current-controlled LED which has a voltage sensing integrated circuit incorporated into a small LED package.

The only additional circuit component necessary to build a voltage monitor is a suitable zener diode, or string of forward biased diodes, to bring the device into its normal operating range. The RCL-400 is designed to turn *on* at 3 V and *off* at 2 V; thus normal operation can be provided by selecting Vz = Vcc - 3 V (See Fig. 1). When Vcc drops to Vz + 2 V, the LED is switched off by the internal IC voltage sensing circuit to give a low voltage indication. Since the device has a relatively constant current demand in the *on* region (~ 10 mA), the zener power rating need only be ¼ W for most battery-powered equipment. One precaution is necessary: You must be sure that the voltage across the LED does not exceed 5 V (its maximum rating).

For low voltage IC circuits using a nominal 4.5 V battery pack, the required value of Vz is only 1.5 V. It is easy to obtain this value by simply substituting a pair of silicon diodes in series with the LED. ■

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73-7

The Morse Clock

- - timely repeater ID

Robert J. Souza WA1MXV
46 Fielding St.
New Bedford MA 02745

A clock which sends the time of day in Morse code can be a useful addition to any modern repeater. Aside from providing mobiles with the correct time of day, the clock may be used to write the time of day on cassette tape for logging purposes when an autopatch or other event occurs. This article describes such a clock constructed for the WR1ADR 60/00 repeater in South Dartmouth, Massachusetts.

The Morse code clock has the following features:

1. Low chip count (17 ICs compared to 30 in previous designs).
2. Easy timesetting (hours fast, minutes fast and hold).
3. Variable code speed.
4. Six digit LED time display (impressive).
5. Protected against power failure (won't lose time).
6. Time may be sent to either 12- or 24-hour format.

Circuit Description

The heart of the Morse code clock is a National MM5318 PMOS clock chip (Fig. 2). This chip was designed to be used in a system which displays the time of day on a television screen. Unlike most other clock chips which have only multiplexed seven segment outputs, the 5318 has both seven segment and $\overline{\text{BCD}}$ outputs available. Furthermore, each digit (hours, tens-of-hours, etc.) may be selected for output by applying the proper code to the Dx, Dy and Dz digit select lines. This is ideal for application in the Morse code clock, since we want to be able to look at the digits one at a time in order to translate them into Morse and send them. The clock requires either a 50 or 60 Hz input signal. This may be obtained from either the power line or a crystal time base. (More on this later.) The clock chip will operate in either a twelve or twenty-four hour format and has leading zero blanking in the twelve hour mode.

The Design Technique

I decided that a straight-

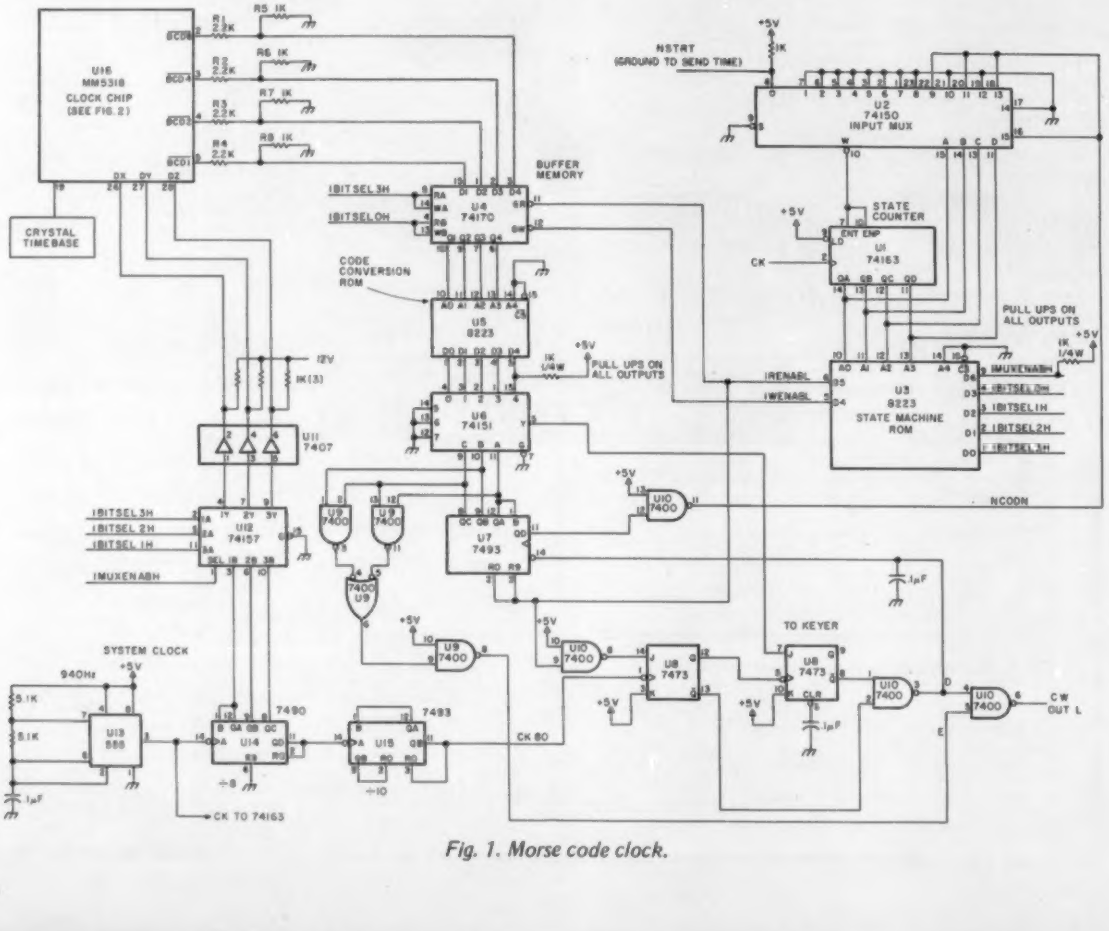
U16
MM5318
CLOCK CHIP
(SEE FIG. 2)
CRYSTAL TIMEBASE
R1 2.2K
R2 2.2K
R3 2.2K
R4 2.2K
R5 1K
R6 1K
R7 1K
R8 1K
BUFFER MEMORY
U4 74170
1BITSEL3H
1BITSEL0H
CODE CONVERSION ROM
U5 8223
PULL UPS ON ALL OUTPUTS
U6 74151
U11 7407
12V
1K(3)
U12 74157
1BITSEL 3H
1BITSEL 2H
1BITSEL 1H
1MUXENABH
U9 7400
U7 7493
U10 7400
NSTRT (GROUND TO SEND TIME)
+5V
U2 74150 INPUT MUX
STATE COUNTER
U1 74163
CK
U3 8223 STATE MACHINE ROM
1RENABL
1WENABL
1MUXENABH
1BITSEL0H
1BITSEL1H
1BITSEL2H
1BITSEL3H
NCODN
SYSTEM CLOCK
940Hz
5.1K
U13 555
1µF
U14 7490
÷8
U15 7493
÷10
CK 60
CK TO 74163
U8 7473
TO KEYER
CW OUT L

Fig. 1. Morse code clock.

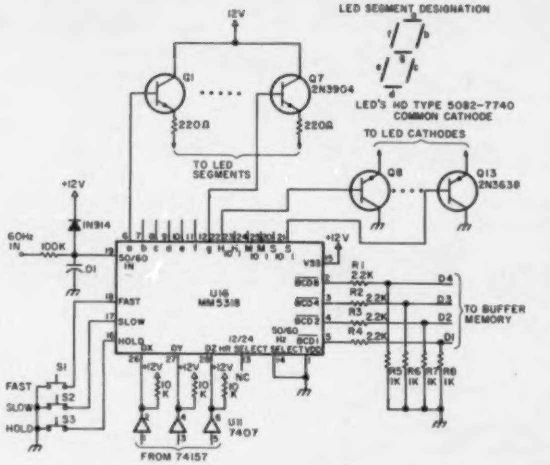
LED SEGMENT DESIGNATION
a
f
b
g
e
c
d
LED'S HD TYPE 5082-7740
COMMON CATHODE
12V
Q1
Q7
2N3904
220Ω
220Ω
TO LED SEGMENTS
TO LED CATHODES
Q8
Q13
2N3638
+12V
IN914
60Hz IN
100K
.01
U16
MM5318
50/60 IN
FAST
SLOW
HOLD
DX
DY
DZ
12/24 HR SELECT
50/60 Hz SELECT
VDD
VSS
BCD8
BCD4
BCD2
BCD1
R1 2.2K
R2 2.2K
R3 2.2K
R4 2.2K
D4
D3
D2
D1
TO BUFFER MEMORY
R5 1K
R6 1K
R7 1K
R8 1K
NC
10K
U11
7407
S1
S2
S3
FAST
SLOW
HOLD
FROM 74157

Fig. 2. Clock chip and display circuitry.

forward way to design the clock was to use the *algorithmic state machine* or ASM design technique. This is a very popular and powerful technique that is often used for the design of computer central processing units (CPUs).

The first step in the ASM technique is to decide exactly what you want the device to do. I did this in the *operational flow chart* of Fig. 3. Initially the clock sits with its seven segment display multiplexed and waits for a START signal. When it receives this signal, it rapidly stores the time of day in a buffer memory. It then reads the digits out of the buffer one at a time and sends them in Morse code. After the last digit has been sent, the display is again multiplexed and the clock waits for another START signal. The time of day must be rapidly read into the buffer because it is possible for the time of day to change while it is being sent. This could cause an error. Consider the case where the time changes from 2359 to 0000 after the first digit (the "2") had been sent! Rapidly loading the time into the buffer minimizes the chance of an error occurring.

Fig. 4 shows the *system block diagram* for the Morse code clock. A ROM centered state machine controller is driven by the system clock and controls three peripheral circuits. These are the clock chip and display, the buffer memory, and the BCD-to-Morse converter.

System Clock (U13, U14, U15)

The system clock is an LM555 timer IC wired as an astable multivibrator with a free running frequency of about 940 Hz. It is divided by a 7490 and 7493 counter (U14 and U15) to about 12 Hz for use in the BCD-to-Morse converter. The output lines of the 7490 (U14), which are varying at a 940 Hz rate, are used to multiplex the seven segment display when the clock is not sending the time.

The State Machine

The state machine controller is made up of U1, U2 and U3. These three chips control the operation of the rest of the circuit. U1, a 74163 4-bit synchronous counter, is the state counter. Its binary outputs determine the present state. There are sixteen possible states for this machine.

The state counter is driven by the system clock, but the only way to have it advance to the next (sequential) state is to have a logic "1" present on the 74163 enable inputs (ENT and ENP). The enable inputs are connected to the output of U2, a 74150 16-to-1 data selector. U2 is the input multiplexer. It acts like a single pole, 16-throw logic switch. The input select lines of U2 are connected to the state counter output lines, so that we look at a given input in each state. The way to advance to the next (sequential) state, then, is to have the selected input condition be true. (Note that the output of the 74150 is inverted, so for the output of the MUX to be true, or logic "1", the input must be false, or logic "0".)

U3, an 8223 32 x 8 ROM, is called the *state machine ROM.* Its address lines are connected to the state counter's output lines. In any state, the ROM may be programmed to generate any combination of eight possible outputs. (Only seven of the outputs were needed for the Morse code clock.) The ROM is simply a replacement for the combinational logic (NAND and NOR gates, etc.) which would be required to generate the outputs. The contents of the state machine ROM are shown in Fig. 5.

In a given state (as determined by the state counter output lines) certain outputs are issued from the state machine ROM and a given input condition is tested by the input MUX. If the condition is false, the machine remains in the present state and continues to issue the outputs required in that state. If the condition is true, the machine advances to the next sequential state on the next positive transition of the system clock. This is often represented graphically as in Fig. 6, which illustrates the case in which the machine waits in state A, corresponding to state counter output 0010, and issues output LITEON (which is active-high as indicated by the H prefix) until input PUSH goes to 0.

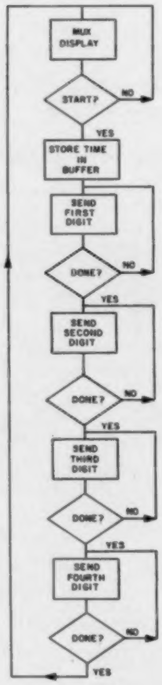
MUX DISPLAY
START?
NO
YES
STORE TIME IN BUFFER
SEND FIRST DIGIT
DONE?
NO
YES
SEND SECOND DIGIT
DONE?
NO
YES
SEND THIRD DIGIT
DONE?
NO
YES
SEND FOURTH DIGIT
DONE?
NO
YES

Fig. 3. Operational flowchart.

A little thought will reveal that this is a very powerful design technique. Since the outputs are programmed into ROM, they may be changed by merely reprogramming, without making any circuit

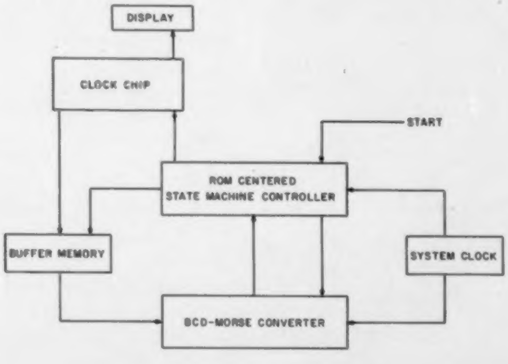
DISPLAY
CLOCK CHIP
START
ROM CENTERED STATE MACHINE CONTROLLER
BUFFER MEMORY
SYSTEM CLOCK
BCD-MORSE CONVERTER

Fig. 4. System block diagram.

ROM Output Lines

STATE	IBITSEL3H	IBITSEL2H	IBITSEL1H	IBITSEL0H	IWENABL	IRENABL	IMUXENABH	COMMENTS
0000	1	1	1	0	1	1	1	wait for NSTRT, MUX display
0001	1	1	1	0	1	1	0	address 10s of hours
0010	1	1	1	0	0	1	0	write into buffer
0011	1	1	0	1	1	1	0	address 1s of hours
0100	1	1	0	1	0	1	0	write into buffer
0101	1	0	1	1	1	1	0	address 10s of minutes
0110	1	0	1	1	0	1	0	write into buffer
0111	0	0	1	0	1	1	0	address 1s of hours
1000	0	0	1	0	0	1	0	write into buffer
1001	1	1	1	0	1	0	0	send first digit (10s of hours)
1010	1	1	0	1	1	1	0	clear BCD-to-Morse converter
1011	1	1	0	1	1	0	0	send second digit (1s of hours)
1100	1	0	1	1	1	.	0	clear BCD-to-Morse converter
1101	1	0	1	1	1	0	0	send third digit (10s of minutes)
1110	0	0	1	0	1	1	0	clear BCD-to-Morse converter
1111	0	0	1	0	1	0	0	send fourth digit (minutes)

Fig. 5. Control ROM program.

changes.

Clock Chip and Display

The features of the MM5318 clock chip have already been described. U11, a 7407 high voltage open collector buffer, acts as an interface between the TTL and MOS logic levels for the clock chip Dx, Dy and Dz lines. U12, a 74157 quad 2-to-1 MUX, acts as a 4PDT logic switch and causes the binary code applied to the MM5318 digit select lines to come from either U14 (which causes the display to multiplex) or from the state machine ROM. The 74157 is also controlled by the state machine ROM. R1-R8 are voltage dividers and convert the MOS levels out of the clock chip to TTL levels. Transistors Q1-Q13 and associated resistors are used to interface the common-cathode LED display to the clock chip. Pin 19 of the clock chip is the 50/60 Hz input. For 60 Hz input, ground pin 14, for 50 Hz, leave it open. If you choose to use a crystal timebase instead of stealing the 60 Hz from the power line, the 1N914 and RC network at pin 19 may be eliminated. The timebase I used was purchased from S. D. Sales and assembled according to their instructions. It was cheaper to buy the timebase from S. D. Sales than to build my own. S1-S3 are push-button switches which are used to set the time.

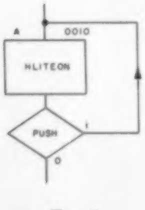

Fig. 6.

The Buffer Memory

U4, a 74170 4 x 4 register file, is used as the buffer memory for the time. The time of day output from the clock chip (in BCD) is written into and read from the buffer memory under direct control of the state machine ROM.

BCD-to-Morse Converter

The output of the buffer memory is connected to the address lines of U5, the 8223 code conversion ROM. This ROM converts BCD to an intermediate code in which a 0 represents a dit and a 1 a dah. The contents of the code conversion ROM are shown in Fig. 7. Note that the ROM will convert a blanked first digit (which occurs when the clock chip is in the twelve-hour mode) to a Morse code 0. Say, for example, that a "7" (1000 – remember, the BCD is inverted) is input to the ROM. 00011 will appear on the ROM output lines. With reference to the schematic and the timing diagram (Fig. 8), when the state machine brings RENABL low, U7, a 7493 counter, is enabled, and the 74151 MUX (U6) passes the least-significant bit of the ROM output (a "1" in this case). U8, a dual J-K flip-flop, and NAND gate U10 make up a variation of the well-known TO keyer. The "1" on the MUX output causes the TO keyer to send a dah. U7 clocks on the falling edge of the dah causing the MUX to select the next most significant bit of the ROM output. After the five bit ROM output has been scanned and sent, the MUX selects input lines 5, 6 and 7, which are hardwired to logic "0". This will cause three additional dits to be sent. U9, a 7400, blanks these dits and they form the space between numerals. After five code elements and a space have been sent, output NCODN goes low, signalling to the state machine that a complete Morse code numeral, including space, has been sent. The state machine may then bring RENABL high to reset the converter, present new BCD data (by changing the buffer memory address), and bring RENABL low to repeat the sequence.

In summary then, if BCD data is presented to the BCD-to-Morse converter input and RENABL is taken low, the BCD-to-Morse converter will generate the sequence of dits and dahs corresponding to the inputted data, a three dit space, and then signal that is is finished by taking NCODN low.

The ASM Chart

Fig. 9 shows the ASM chart for the Morse code clock. It shows all the states, the outputs issued in each state, and the inputs required to advance to the next state. If no input condition is shown in a given state, it is assumed that the machine advances to the next sequential state on the next positive transition of the system clock. A table of the state machine inputs and outputs is shown in Fig. 10.

Power Supply

The power supply for the Morse code clock is shown in Fig. 11. A 12.6 volt 1.2 Ampere transformer (from Radio Shack) is used in a full wave bridge to provide 12 volts for the display and the clock chip. An LM309K regulator (mounted on a heat sink) provides a regulated 5 volts for the TTL logic. Diodes D1 and D2 are used to automatically switch in a nicad pack if the power fails. Note that the nicads will reverse-bias D1, turning off the display when the power fails to conserve current. R1 is used to trickle charge the nicads and should be selected to provide the required charging current.

Construction Notes

The clock was built on a wire-wrap prototyping board. I like this method of construction because it allows me to test the circuit as I build and also allows for easy modification (and correction of mistakes!). The wire-wrap board was mounted in a 9" x 11" x 2" chassis along with the power supply and time

Digit	ROM Address	ROM Contents
0	1111	11111
1	1110	10000
2	1101	11100
3	1100	11000
4	1011	10000
5	1010	00000
6	1001	00001
7	1000	00011
8	0111	00111
9	0110	01111
blank	0000	11111

Fig. 7. Code conversion ROM contents.

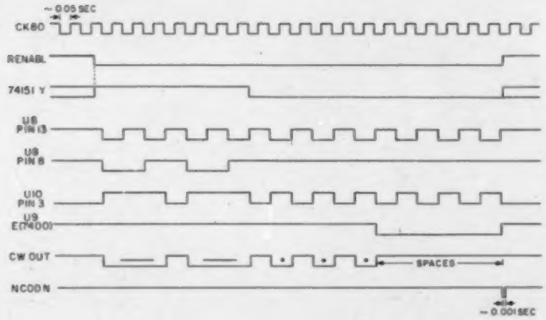
~0.05 SEC
CK80
RENABL
74151 Y
U8 PIN 13
U8 PIN 8
U10 PIN 3
U9 E(7400)
CW OUT
SPACES
NCODN
~0.001 SEC

Fig. 8. BCD-Morse converter timing diagram.

setting buttons. The six digit LED display was mounted on the front panel of the repeater in an IEE six readout mounting bezel which was purchased from Tri-Tek. This bezel makes a very professional looking and reasonably inexpensive display. The LED display is connected to the clock with a 14 wire ribbon cable.

The clock tends to run quite warm (especially the ROMs and the Buffer Memory) so I punched six 1" holes around the perimeter of the chassis. The holes were covered with perforated aluminum to complete the shielding of the clock.

The clock chip and the chip in the crystal timebase are MOS devices and as such are susceptible to damage from static discharge. Handle them with care. Do not remove them from their protective packaging until ready to install them. Do not insert or remove them from the circuit with the power on. If you choose to solder these chips in, ground the tip of your soldering iron.

The programming procedure for the Signetics 8223 ROMs has been described many times before and will not be repeated here. The references at the end of the article should be consulted for the proper procedure.

Vcc was bypassed to ground with 0.01 uFd 50 volt ceramic capacitors at the rate of one capacitor for every three ICs. Do not omit the 0.1 uFd capacitor from pin 6 of U8 to ground. It performs a power-on reset for the flip-flop. The capacitor in the system clock circuit determines the system clock frequency and ultimately the CW speed. If a cheap ceramic capacitor is used here the CW speed will change as the clock heats up. I used a sealed mylar unit.

Interfacing the Clock and Repeater

All interconnections between the clock and the repeater control logic are active-low. This allows the clock to be removed from the repeater without affecting the repeater logic.

Grounding input NSTRT will start the time sending cycle. NSTRT should return to 5 volts before the clock is finished sending the time or else it will repeat. In our repeater NSTRT comes from the touchtone™ decoder output. The clock is activated by a single touchtone digit.

Output IMUXENABH goes low during the time sending cycle and may be used to hold the repeater transmitter on.

CWOUTL is the active-low CW output from the clock. It may be used to drive an audio oscillator as shown in Fig. 12 if none is available in the repeater.

Push-button switches S1 and S2 cause the clock to advance one hour per second and one minute per second respectively. S3 will stop the clock for synchronization to the exact second with WWV or CHU.

When the clock is first powered up it may begin sending the time. It will cycle once and then stop. Also, all the digits in the display may not be illuminated. Merely advance the clock with S1 and S2 until all the digits light up. It is a good idea to cycle the clock through all 24 hours when first powering it up, since it is possible for it to count up to 30 hours the

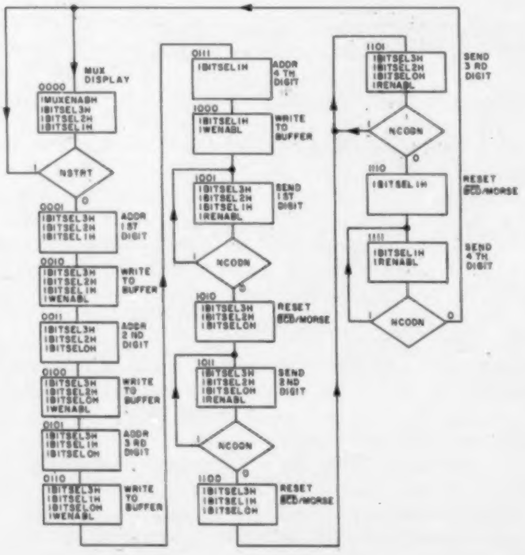
MUX DISPLAY
0000
IMUXENABH
IBITSEL3H
IBITSEL2H
IBITSEL1H
NSTRT
1
0
0001
IBITSEL3H
IBITSEL2H
IBITSEL1H
ADDR 1 ST DIGIT
0010
IBITSEL3H
IBITSEL2H
IBITSEL1H
IWENABL
WRITE TO BUFFER
0011
IBITSEL3H
IBITSEL2H
IBITSEL0H
ADDR 2 ND DIGIT
0100
IBITSEL3H
IBITSEL2H
IBITSEL0H
IWENABL
WRITE TO BUFFER
0101
IBITSEL3H
IBITSEL1H
IBITSEL0H
ADDR 3 RD DIGIT
0110
IBITSEL3H
IBITSEL1H
IBITSEL0H
IWENABL
WRITE TO BUFFER
0111
IBITSEL1H
ADDR 4 TH DIGIT
1000
IBITSEL1H
IWENABL
WRITE TO BUFFER
1001
IBITSEL3H
IBITSEL2H
IBITSEL1H
IRENABL
SEND 1 ST DIGIT
NCODN
1010
IBITSEL3H
IBITSEL2H
IBITSEL0H
RESET BCD/MORSE
1011
IBITSEL3H
IBITSEL2H
IBITSEL0H
IRENABL
SEND 2 ND DIGIT
NCODN
1100
IBITSEL3H
IBITSEL1H
IBITSEL0H
RESET BCD/MORSE
1101
IBITSEL3H
IBITSEL2H
IBITSEL0H
IRENABL
SEND 3 RD DIGIT
NCODN
1110
IBITSEL1H
RESET BCD/MORSE
1111
IBITSEL1H
IRENABL
SEND 4 TH DIGIT
NCODN

Fig. 9. Morse clock ASM chart.

State Machine Signals

OUTPUTS	
IBITSEL3H IBITSEL2H IBITSEL1H IBITSEL0H	select clock digit and buffer memory address
IWENABL	when low, writes time into buffer
IRENABL	when low, reads time from buffer and sends it in Morse
IMUNENABH	when high, causes LED display to multiplex, when low causes clock digit to be selected by IBITSEL0-IBITSEL3
INPUTS	
NSTRI	goes low to start time sending sequence
NCODN	goes low to indicate that a complete numeral and space have been sent in CW

Fig. 10.

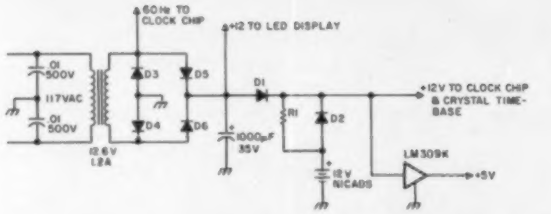

Fig. 11. Power supply.

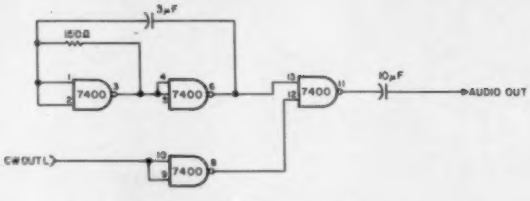

Fig. 12. Audio oscillator.

first time through.

Changing the CW Speed

The speed of the CW output is determined by the frequency of CK80, the input to the BCD-to-Morse converter. The output speed is equal to 1.2 times CK80, in wpm. CK80 in my clock is 940/80, or 11.75 Hz. The output speed is then 1.2 x 11.75, or 14.1 wpm.

CK80 *may* be varied by changing the value of the 0.1 uF capacitor in the system clock. This is not really a good idea, since the system clock is also used to multiplex the seven segment display, which will flicker if the multiplex frequency is too low. A better way to alter the CW speed is to change the division ratio of U15. Say, for example, that an output of 10 wpm is needed. CK80 must therefore be 10/1.2, or 8.33 Hz. This requires a division ratio in U15 of 94/8.33, of 11.28. If U15 is set to divide by 12 (by connecting pin 2 to pin 8 instead of pin 9), the output speed will be 9.4 wpm. The CW output speed may be varied from 9.4 wpm to over 100 wpm by merely changing the division ratio of U15.

Getting the Parts

At the time of writing, nearly all of the parts for the Morse code clock were available from James Electronics. I bought the HP 5082-7740 common cathode seven segment LED readouts and the crystal timebase from S. D. Sales. The chassis and other odds and ends were obtained locally.

Thanks to the ASM design, the Morse code clock worked immediately when powered up. It has been in operation at the WR1ADR 60/00 repeater in South Dartmouth MA for about six months without any problems. My thanks to K1IBR and the rest of the crew at SEMARA for their cooperation and support. I will be glad to correspond about the Morse code clock or ASM design. An SASE would be appreciated. ■

References

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2. R. Jaeger, "Microprogramming: A General Design Tool," ***Computer Design,*** August, 1974, p. 150.
3. J. B. Peatman, ***The Design of Digital Systems,*** McGraw-Hill.
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Hunting Noise

- - with a grid dipper

John P. Dieringer W6RVP
9010 Ramsgate Avenue
Los Angeles CA 90045

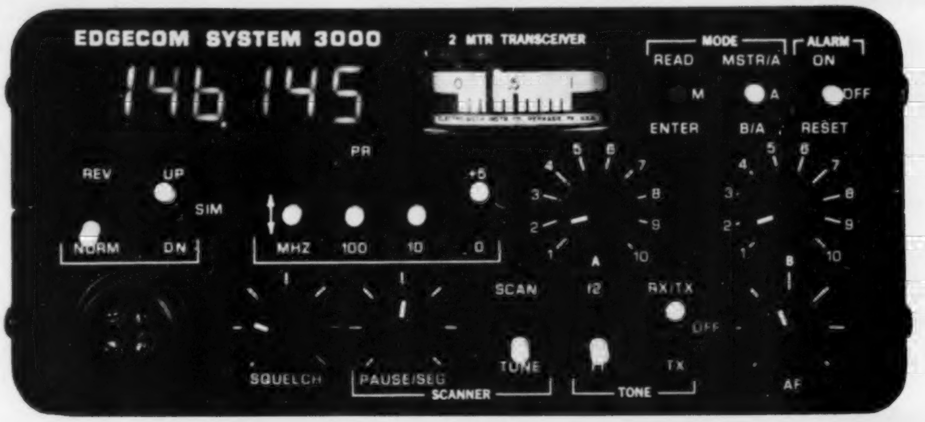
Noise external to receiving equipment can sometimes be difficult to pinpoint. A spectrum analyzer is beyond the reach of most amateurs. Here is a cheap substitute that has been proven.

Some time ago man-made interference was tearing up communications across a wide spectrum, seriously upsetting some military operations. Engineers tried to solve this with a spectrum analyzer and failed. As hams, a friend and myself were asked if we could solve this. A little thought as to why the engineers failed led us to the conclusion that their equipment was too sophisticated. I devised the idea of using my Heathkit grid dipper and a scope. The scope was hooked to the internal dipper diode and ground. At 2 MHz there was plenty of grass when the dipper coil was placed near any building wiring. Reducing the scope sensitivity, the grass was barely noticeable. We probed around. It didn't take long to locate a relay used for aircraft obstruction lights that was defective, with pitted chattering contacts.

Any battery operated dipper can be used. It can be hooked up to the audio section of a battery operated portable radio for use away from the shack. Make sure the dipper switch is in the diode position, so it is being used as a field strength meter. To hook the dipper up, solder one wire to the output side of the dipper diode and the other wire to ground. These wires go either to the scope vertical input or, in the case of a radio, to the volume control. Do not wire to the volume control center tap.

Tuning the dipper to harmonics, hunting parasitics, or debugging a transmitter is easy, too, since the scope gives an excellent visual display. ■

WHEN SYSTEM 3000 BYTES



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- **AUDIO/VISUAL ALARM** to let you know when the monitored priority channel is occupied or when tone-coded squelch is activated.
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CMOS Oscillators

-- practical techniques

Over the past few years, many articles have appeared in various electronics magazines dealing with the subject of oscillators and their applications. Of these articles, the majority have dealt primarily with transistor and TTL circuits.

While these devices have performed exceedingly well in many applications, there are other devices available that may be more suitable for certain applications. For example, CMOS devices perform well in low power circuits and can operate satisfactorily from a wide range of supply voltages (typically +3 to +15 volts). These two features make CMOS devices ideal for compact, low power, portable equipment capable of operating from a variety of power sources.

This article, then, is an attempt to provide basic application information on CMOS oscillator circuits as well as providing an overview of basic CMOS features and characteristics. As you will see, they are very versatile devices that are easy to use once you become accustomed to their peculiarities.

CMOS integrated logic circuits offer several distinct advantages over other logic families. Some of these advantages may be summarized in the following:

1. *High Noise Immunity*: To understand this characteristic, it will be necessary to refer to the transfer characteristic curve for a typical CMOS IC inverter. Fig. 1 shows this transfer characteristic, which is the relationship between the input and output voltages. Note that the output voltage is affected by a change in the input voltage only at the transfer point. The steepness of this curve also indicates that as the transfer point is reached, there is an abrupt change or a "toggling" of the output.

Usually, the transition voltage is specified to occur between 30% and 70% of the power supply voltage. Thus, for a 15 volt power supply, the input noise transient would have to exceed 4.5 volts for it to affect the output. This feature provides for very stable monostable multivibrator circuits where the CMOS device is used as a one shot trigger source.

2. *Low Power Requirements*: Almost everyone is now familiar with the low power consumption of CMOS devices. This feature is one of the primary considerations for using CMOS devices in digital watch circuits.

The CMOS family exhibits low power consumption due to the way the output transistors are connected — in series, so that power is consumed only during transistion states. All CMOS devices incorporate at least two MOS transistors in series — one p-channel and one n-channel. Consequently, only one transistor is turned on at a time and there is no direct path for current to flow. The only exception to this rule is during transition states, and then only for very short time periods. Fig. 2 is a diagram showing the output transistors.

Note that as the frequency of the oscillator circuit is increased, the conduction times also increase, so that power consumption is directly proportional to the operating frequency. Typical quiescent dissipation for an inverter, however, is less than 300 uW per package for a 10 volt supply (CD4009A).

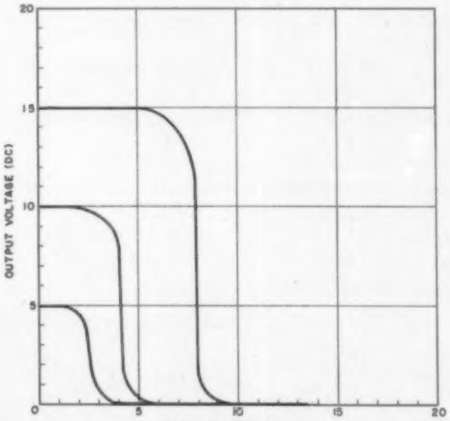

Fig. 1. Transfer characteristics for a typical CMOS inverter at 5V, 10V, and 15V.

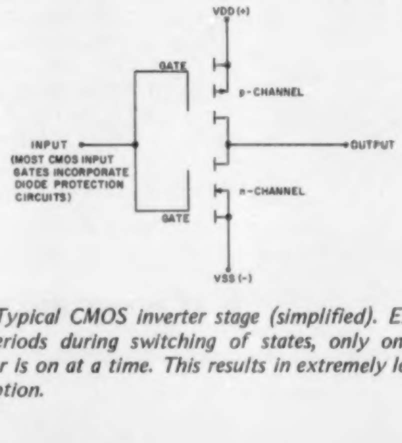
VDD (+)
GATE
p-CHANNEL
INPUT
(MOST CMOS INPUT GATES INCORPORATE DIODE PROTECTION CIRCUITS)
OUTPUT
n-CHANNEL
GATE
VSS (-)

Fig. 2. Typical CMOS inverter stage (simplified). Except for short periods during switching of states, only one output transistor is on at a time. This results in extremely low power consumption.

3. *Wide Range of Power Supply Voltage*: Another fea-

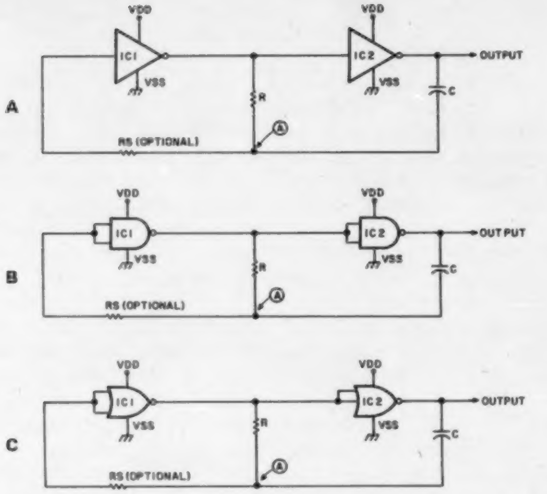

Fig. 3. Three typical CMOS astable multivibrator circuits. (a) CMOS inverter astable multivibrator. IC1, IC2 = 1/6 CD4069. (b) CMOS NAND astable multivibrator. IC1, IC2 = CD4011. (c) CMOS NOR astable multivibrator. IC1, IC2 = CD4001.

ture that is unique to CMOS devices is the wide range of supply voltages over which they will perform satisfactorily. Typically, most manufacturers guarantee operation over a range of 3 volts to 15 volts. However, some versions will operate up to 18 volts. With this feature, it's not necessary to design well-regulated power supplies and, in most cases, batteries work just fine. Also, the voltage range makes CMOS devices ideal for automotive or mobile applications.

4. *Wide Temperature Range*: The usual package most hams or hobbyists will be working with is the dual-in-line plastic package (suffix AE or BE). This unit is suitable for a temperature range of -40°C to +85°C. The more expensive ceramic version (suffix AF or BF) will operate over a temperature range of -55°C to +125°C.

5. *High Input Impedance*: The input gates of all CMOS devices have impedances on the order of 10^{12} Ohms. This results in extremely low input current requirements (typically ± 10 pA) and consequently very little loading on the input circuit. Another advantage resulting from this high input impedance is directly applicable to oscillator circuits. The high input impedance makes it possible to obtain large time constants without the use of large capacitors. This means that CMOS devices can provide cost and size reductions in most multivibrator circuits.

Before we get into some actual multivibrator applications, a word of caution is in order. Since an inverter functioning as an oscillator operates a considerable amount of time in the linear region of its transfer curve, some CMOS devices cannot withstand the high power dissipation. These devices include the CD4009A and CD4010A. Instead of using these devices, the CD4049 and CD4050 would make a better choice.

Astable Multivibrator Circuits

An astable multivibrator is basically an oscillator that generates a square wave output at a specific frequency. The frequency of the square wave may be determined by an RC circuit, crystal, or analog voltage.

Astable multivibrators may be constructed from a basic inverter IC or from NAND or NOR gates connected as inverters. Fig. 3 shows three basic types of astable RC multivibrators.

All CMOS gates have a built-in diode protection circuit to clamp large input voltages and prevent the gate from being destroyed. To minimize the effect of this input circuit on stability, a resistor (Rs) is connected from the timing circuit to the input of the first inverter. This, in effect, limits the current to the input gate.

In operation, the input of the first inverter is clamped at approximately Vdd or Vss, whichever is appropriate. At any particular instant, capacitor C will be charging or discharging through resistor R. When the capacitor is discharging, the voltage decays at point A until transfer occurs for inverter 1 and its output switches from zero level to the power supply voltage, causing the output of IC2 to switch from the power supply voltage to zero. When this occurs, capacitor C begins to charge. This continues until the voltage at point A builds to the transfer point. When this occurs, the output of IC1 switches to zero volts, causing the IC2 output to switch to the positive supply voltage. At this point, the cycle is ready to begin again.

The frequency of the square wave output will be dependent on the values chosen for R and C. Also, to limit current at the input gate of IC1, the rule of thumb is that Rs should be approximately twice the value of

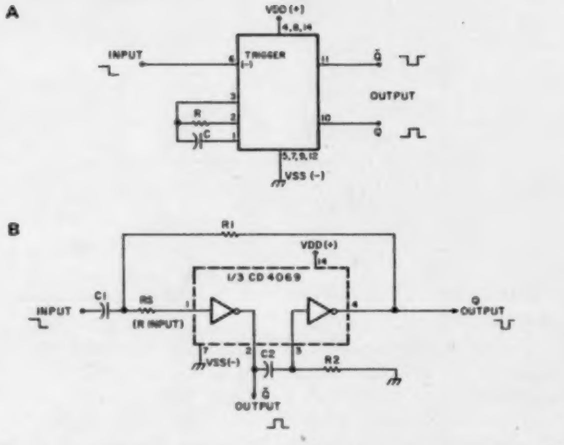

Fig. 4. Monostable multivibrator circuits for negative-going input pulses. (a) CD4047. (b) CD4069 (hex inverter).

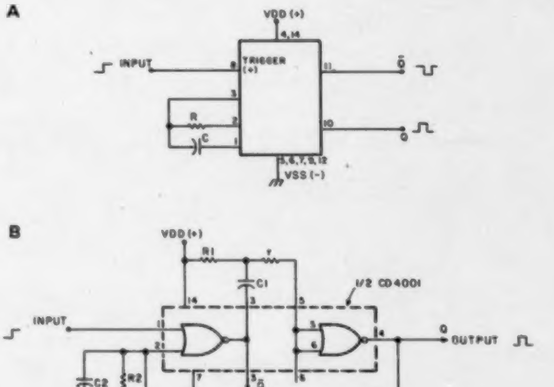

Fig. 5. Monostable multivibrator circuits for positive-going input pulses. (a) CD4047. (b) CD4001 two-input quad gate.

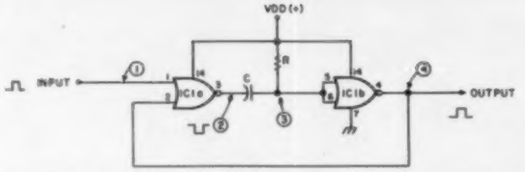

Fig. 6. Basic one-shot multivibrator circuit using two NOR gates. IC1a and IC1b = ½ CD4001.

resistor R.

Monostable Multivibrator Circuits

A monostable multivibrator is a logic circuit that generates, upon command, a single output pulse of set duration. It is commonly referred to as a "one-shot" multivibrator. There are monostable circuits that are triggered by a negative-going input pulse (Fig. 4), as well as circuits that are triggered by a positive-going pulse (Fig. 5). Both of these circuits may not be retriggered until they return to steady state conditions. Hence, they are often used to debounce mechanical switches in a variety of applications.

To understand how monostable multivibrators function, refer to the circuit shown in Fig. 6. This diagram shows two NOR gates from a quad CD4001 connected in series. This basic one-shot circuit operates with a single RC time constant. When a positive-going input pulse is applied to the input at 1, it causes the output of IC1a to go to ground potential (zero volts). This in effect grounds the input of IC1b until capacitor C charges up to the transfer level. During this timing period, the output of IC1b is at V+. When point 3 reaches the transfer level, the output of IC1b switches to zero, causing the input of IC1a to become zero. Assuming there is no input signal on the other input, the output of IC1a switches to V+ and the circuit is ready to be triggered again. It is important to note that this circuit, once triggered, is immune to further triggering (or noise) until the timing cycle is complete and the circuit is reset.

If the power source (V+) is greater than +5 volts, you may want to include a series resistor at IC1b to limit the input current at the gate.

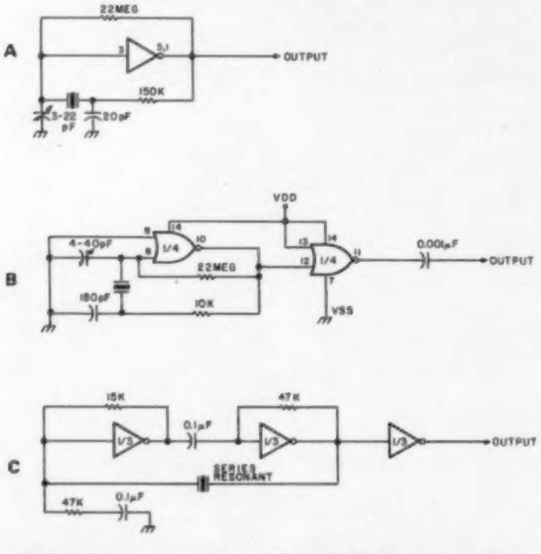

Fig. 7. CMOS crystal oscillators. (a) MC14007 or CD4007. Pin 7 – Vss. Pin 14 – Vdd. Note: Pins 5 and 1 must be connected together for proper operation. (b) CD4001. (c) CD4049.

CMOS Crystal Oscillators

CMOS devices make excellent and stable oscillators when a crystal is used as the frequency determining element. Fig. 7 shows several circuits for CMOS crystal oscillators using a variety of devices.

Generally, crystal oscillators using CMOS devices operate in the frequency range of 10 kHz up to a top limit around 10 MHz. For lower clock rates, the basic oscillator stage is connected to divider circuits until the correct clocking rate is achieved.

Voltage Controlled Oscillators

Previously, we discussed a type of oscillator whose frequency was determined by a fixed RC circuit. By changing the value of R (or C), the frequency of the oscillator will be varied proportionately.

A voltage controlled oscillator is merely a standard RC astable multivibrator in which the value of the resistor R is varied by a control voltage. Just how this is accomplished is illustrated in Fig. 8. "R" has been replaced by a semiconductor device whose resistance varies from 1k to 10k. These limits are determined by a parallel combination of R1 (10k) and the resistance of an n-channel device which varies from 1k ("on" state) to 10^9 Ohms ("off" state). The center frequency of the VCO may be determined by varying the value of capacitor C.

Phase Locked Loops

Using the VCO discussed above as the basic circuit, it's possible to build a phase locked loop (PLL) using CMOS devices. Suppose we could compare the output frequency of a VCO to a reference frequency and develop an error voltage with a magnitude proportional to the frequency deviation. If this error voltage was fed back to the input of the VCO, its output frequency could be corrected back to the reference frequency. In so doing, the two circuits would lock in phase at the reference frequency.

It is interesting to note that the CMOS family of devices has a phase locked loop element which is unique to the CMOS family – there is no TTL equivalent. This device is the CD4046 and a typical PLL circuit is shown in Fig. 9.

In this circuit, the minimum output frequency occurs when the input control voltage is at zero. When the input control voltage is at the power supply level, the output frequency is at a maximum.

Frequency Multipliers

In this application, CMOS devices may be used to build circuits that generate output signals having a frequency equal to a multiple of the input signal frequency.

An example of a multiply-by-two circuit is shown in Fig. 10. It's also possible to

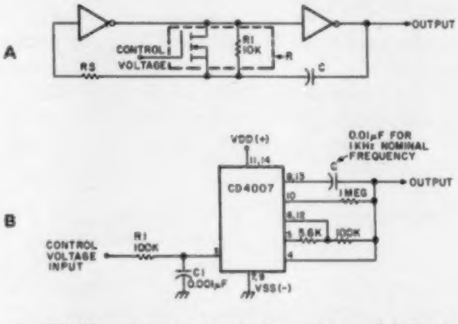

Fig. 8. CMOS voltage controlled oscillator. (a) Basic diagram, CD4007. (b) Practical circuit.

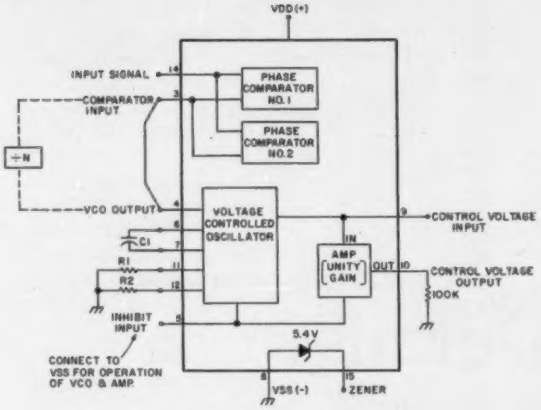
VDD(+)
INPUT SIGNAL
14
COMPARATOR INPUT
3
PHASE COMPARATOR NO. 1
PHASE COMPARATOR NO. 2
÷N
VCO OUTPUT
4
VOLTAGE CONTROLLED OSCILLATOR
6
C1
7
R1
11
R2
12
INHIBIT INPUT
5
CONNECT TO VSS FOR OPERATION OF VCO & AMP.
9
CONTROL VOLTAGE INPUT
IN
AMP (UNITY GAIN)
OUT
10
CONTROL VOLTAGE OUTPUT
100K
5.4V
8
VSS(-)
15
ZENER

Fig. 9. CD4046 CMOS phase locked loop (PLL). For 1 kHz: R1 – 1 meg; R2 – 00; C1 – 0.01 uF.

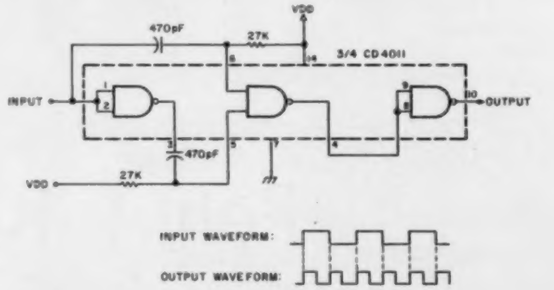
VDD
470pF
27K
6
14
3/4 CD4011
INPUT
1
2
9
8
10
OUTPUT
3
470pF
5
7
4
27K
VDD
INPUT WAVEFORM:
OUTPUT WAVEFORM:

Fig. 10. CMOS multiply-by-two circuit.

build more sophisticated multiply-by-n circuits by using a PLL and a divide-by-n in the feedback circuit.

In the multiply-by-two circuit, two RC circuits are used with an inverter to produce negative pulses on one input of the NAND gate when the input goes positive. A second negative pulse occurs at the input of the other NAND gate when the input signal goes negative.

As with any two-input NAND gate, a negative pulse on *either* input gate causes the output to become positive. Hence, the output frequency will be twice the input frequency.

Additional Information

There are several sources of information available to you for further investigation of CMOS devices. The following publications will provide you with a wide range of reference information: "Understanding CMOS Integrated Circuits," R. Melen & H. Garland, (H.W. Sams); "COS/MOS Integrated Circuits," RCA Solid State; "MOS/CCD Data Book," Fairchild Semiconductor; "CMOS Integrated Circuits," National Semiconductor; "McMOS Handbook," Motorola.

In addition, the "Electronics Sourcebook" contains a handy index of industry application notes and publications relating to CMOS devices. It's available for $3.75 postpaid from Technical Publications, 1405 Richland Ave., Metairie, LA 70001.

I would be interested in hearing from readers who have unique applications for CMOS devices as described in this article. If there is enough response, there may be a follow-up article about CMOS devices in other applications. ■

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Paramus NJ 07652

A Dial for the FM-DX

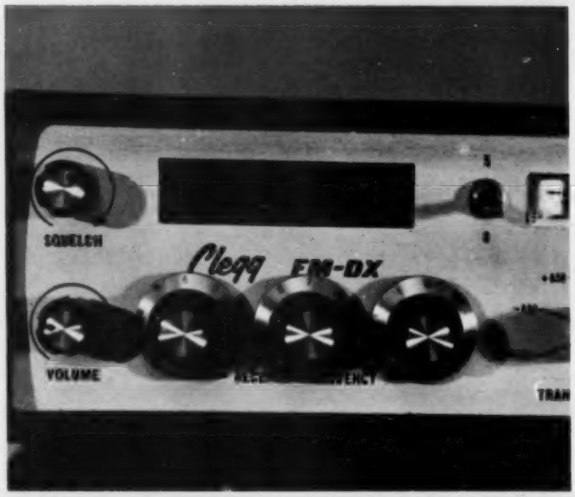
- - in case the LEDs fail

Readers of *73* may be interested in a modification performed on my FM-DX. Recently I had one of the LEDs in the digital display go out on me, presenting the problem of guessing how to dial up frequencies.

While waiting for a new LED to arrive, I solved the guessing game by installing indexed knobs on the three selector switches. As the picture shows, with no LED display, it is now possible to dial up a frequency using only the knobs. This also helps when operating in direct sunlight.

The knobs used were obtained at Radio Shack (Cat. No. 274-413) and are numbered 0-9, exactly as needed for this application. The diameter of these knobs was too large, however, and required removal of approximately 1/8" from the outside edge. A little careful machining with a drill press and file corrected this problem.

Catalogs show other knobs available in smaller diameters which would be more suitable, but I had to act in haste for the immediate emergency. ■


SQUELCH
Clegg
FM-DX
VOLUME

Ralph E. Taggart WB8DQT
602 S. Jefferson St.
Mason MI 48854

Robot 400 Scan Converter Details

- - conventional TV as SSTV monitor

If you ask experienced SSTV operators what the major barrier to widespread acceptance of slow scan television might be, you will almost always get the same answer – the display system! Most amateurs are now familiar with the major aspects of the slow scan system first developed by Copthorne MacDonald in the late 1950s. SSTV involves the transmission of a 128 line picture which is transmitted over a period of approximately 8 seconds. This extended frame time, coupled with the modest number of scanning lines, results in a picture format that is compatible with voice bandwidth signals and thus can be transmitted on the high frequency bands using normal SSB phone equipment. At first glance one might assume that the 128 line picture with its limited resolution might be a problem, but most amateurs on seeing a photograph of an SSTV image are quite impressed by the quality of the pictures. The real problem arises when a convert sees his first SSTV demonstration. In order to view a picture that requires 8 seconds for transmission, a conventional monitor must employ a cathode ray tube with a long persistence phosphor, usually a P7 CRT. The long persistence component of this phosphor is not very bright and the pictures can only be viewed effectively under subdued light, hardly the conditions that exist for most demonstrations. The phosphor is quite bright where the screen is actually being scanned, but fades rather rapidly, resulting in a pronounced "window shade" effect as the picture is scanned from top to bottom. Another disturbing feature is that the phosphor is yellow, resulting in black and yellow images rather than the familiar black and white of monochrome TV.

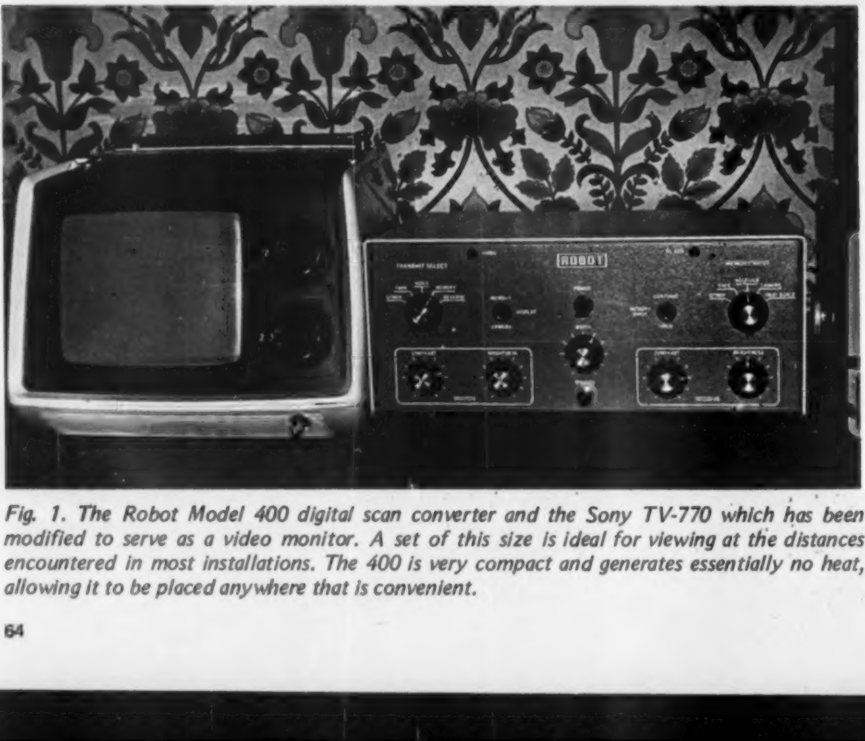


Fig. 1. The Robot Model 400 digital scan converter and the Sony TV-770 which has been modified to serve as a video monitor. A set of this size is ideal for viewing at the distances encountered in most installations. The 400 is very compact and generates essentially no heat, allowing it to be placed anywhere that is convenient.

Slow scan experimenters have long recognized that a conventional TV set represents a very effective display system if there were some means available to convert the slow scan image into a conventional TV picture. This conversion process is known as *scan conversion.* In theory, scan conversion requires some means of storing the incoming SSTV picture and then repeatedly reading out the stored video information at scanning rates compatible with conventional television display. The two most promising approaches to this problem to date have been *analog* scan conversion and *digital* scan conversion, and amateurs have pioneered in the development of each. The analog process involves the storage of the picture by means of a vidicon-like tube with a special silicon target. The picture is painted electronically on the target by scanning at the SSTV rates and, once it is impressed on the target of the tube, it is retained for a considerable period. The charge distribution resulting from the SSTV image is then scanned repeatedly at fast scan rates to produce a conventional TV video signal. The first SSTV analog scan converter was produced by W9NTP and displayed at Dayton several years ago. W2DD and a number of other amateurs successfully experimented with modifications of commercial analog scan converters with some success, and Robot Research of San Diego eventually introduced their Model 300 analog scan converter. This was an effective unit that could not only provide fast scan display of an SSTV picture, but it was also capable of storing a single frame from a fast scan closed circuit TV (CCTV) camera that could then be transmitted in the SSTV format. There were several major restraints to both amateur and commercial efforts in the analog area. The first was cost, due almost entirely to the expense of the special storage tube. Secondly, because such converters are analog devices, the scan converters had a great many interacting level controls that took some practice to use effectively. Finally, the image storage in the tube is not perfect, and the image begins to fade after 10-20 minutes of display. Although the retention factor is not important in some applications, it does limit the device.

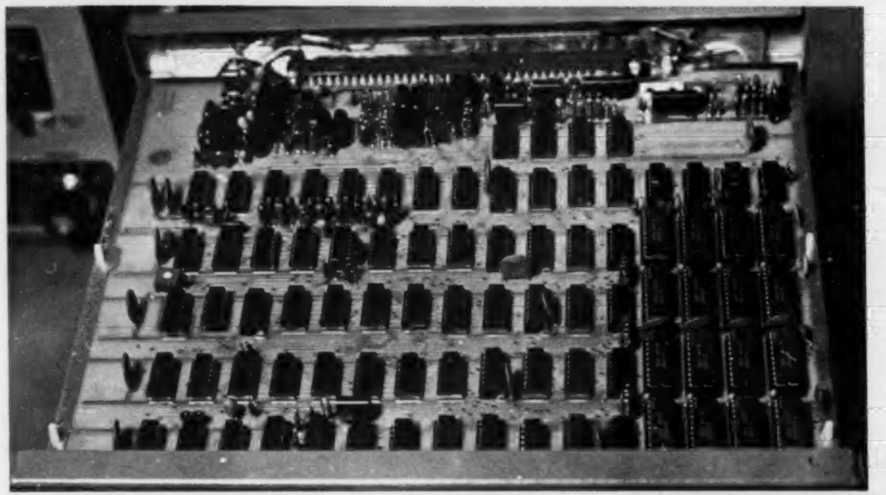


Fig. 2. Internal view of the Model 400 with the top cover removed. Virtually all of the active circuitry is confined to the single large plug-in circuit board. The 16 large ICs in the lower right are the 4K RAM chips that comprise the main memory. All of those other little packages are required to address the memory, perform A/D and D/A conversions, and process both SSTV and fast scan video. Cabinet space below the circuit board is devoted to power supply components. Controls are mounted on the front panel with I/O jacks on the rear panel. The controls and jacks have few discrete components associated with them, and those which are present are used mostly for rf bypassing, resulting in excellent resistance to RFI. Note that sockets are employed for all ICs, easing any problems with servicing and making it relatively easy to experiment with the unit.

The other alternative – digital scan conversion – appeared to offer the greatest long-term promise, but development was impeded by the sheer complexity of the circuitry required. One of the major problems was the sheer size of the digital memory. A 128 line SSTV picture consists of 128 x 128 picture elements or *pixels* – a grand total of 16,384. The solid state memory (in the form of shift registers or later RAM) would have to have a capacity of at least 16,384 bits to store an SSTV picture without loss of resolution. Digital storage, however, is in the form of low or high data bits so that even a 16K bit memory could only store a picture of either white or black pixels with no intermediate gray scale values! Storing gray scale values requires still more memory. Too few gray scale shades and the picture will have a crude paint by numbers appearance known as *video contouring.* Video contouring is essentially unnoticeable on a standard TV display if 32 gray shades are employed, but the memory requirements are excessive. 16 gray scale shades (requiring four bits of memory for coding for each pixel) appears to be the best compromise between memory size and picture fidelity. The memory must therefore consist of 16,384 x 4 bits – a total of 65,536 bits. If the memory is in the form of 1024 bit shift registers, as it is in most current amateur designs, a total of 64 shift register chips are required for the main memory alone. To this must be added the SSTV signal processing circuits, analog to digital conversion (A/D) to convert the analog video to a digital format, slow scan clocks, clocks to circulate the main memory, fast scan clocks and sync circuits, the D/A converters to convert the digital video back to analog form, and finally a series of input and output line buffers (more memory) to clock the video in and out of the main memory. Needless to say, a digital scan converter is a complex project. Beginning just a few years ago, the design and building efforts of W0LMD, W9NTP, and WB9LVI produced working scan converters that were displayed at the annual Dayton extravaganza. Anyone who viewed the clear, non-fading, black and white images displayed by these units could not help but realize that digital scan conversion of SSTV pictures was the wave of the future. Other amateurs worked up PC board layouts for such projects, the LVI unit was described in *QST*[1] and, despite the complexity of undertaking such projects, the home brew SSTV exhibit at Dayton last spring consisted almost entirely of digital scan conversion units. What was needed to bring such technology from the experimenters to the average ham shack was the introduction of comparable commercial equipment. Robot Research, true to its position as a pioneer in the area of commercial SSTV equipment, has done just that with the recent introduction of their Model 400 digital scan converter. One of the early model 400s was obtained to perform an evaluation of the unit's potential, and what follows is the result of that evaluation.

The Model 400, in conjunction with a closed circuit TV monitor or, in some cases, a modified TV set, and a standard CCTV camera, will perform virtually all of the operations required for working two-way slow scan TV. On the display side, it will take an SSTV signal from *any* source – the receiver, tape recorder, SSTV camera, flying spot scanner, or keyboard – and display the picture on a TV monitor. With the flick of a switch you can have each new picture replace the previous one, bit by bit as it comes in, or you can freeze the picture in memory and view it as long as power is applied to the scan converter. Recordings of incoming SSTV pictures can be made directly from the source or from the digital information stored in the memory. A very handy feature of the 400 is its ability to provide "instant replay" of pictures received over the air. If a received picture is held in memory, you can transmit from the memory and thus show the station at the other end what a representative frame looked like at your end. This is particularly useful in critiquing pictures as it is possible to show the other operator that contrast, lighting, composition, or some other factor requires improvement.

The 400 also functions in generating SSTV pictures from a fast scan CCTV camera or other video source. A single frame of fast scan video can be "snatched" and stored in the 400's memory and read out in the SSTV format for transmission and/or recording. Frame snatch can be initiated manually at any time desired or it can occur automatically at the beginning of each SSTV frame. Since a single fast scan frame, occurring over a time interval of 1/60 of a second, is all that is required, motion no longer distorts the image and the subject need not remain motionless during the SSTV frame interval. The 400 permits real time viewing of the fast scan video in its digitized form so that there is no doubt as to how the picture will look when snatched. Levels are set up in the 400 so that the picture as viewed on the monitor is exactly how it will appear at the other end. All frames obtained using the snatch function have a four step gray scale inserted in the last couple of lines in the frame. This is an extremely useful feature as it provides you with a constant contrast reference when setting up the picture as well as providing the operator at the other end with an unambiguous reference against which to judge tuning, his contrast and brightness adjustments, and your video "swing."

The 400 also incorporates a precision 4 step digital gray scale to assist in setting the brightness and contrast on received pictures and providing a comparison scale for setting up the same values in pictures to be transmitted. In short, it would seem that the 400 can do just about anything. Let's look briefly at the physical and electrical characteristics of the unit and then see how this performance potential is actually realized in practice.

Physical Description

The 400 arrives beautifully packed and is unlikely to suffer damage in shipment. It weighs 12 pounds and is packaged in a rugged two-piece aluminum cabinet measuring 12.5 inches wide, 6 inches high, and 11.75 inches deep. The unit is finished in the two-tone gray that is characteristic of the Robot equipment line. A front panel view of the 400 is shown in Fig. 1. All of the active circuitry (including the 16 4K RAM chips for the main memory, 77 other ICs, 19 transistors, and an array of discrete components) is contained on a single magnificent circuit board (Fig. 2). The rest of the cabinet simply serves to hold the power supply, front panel controls, the I/O jacks on the rear apron, and a few components associated with the controls. The main circuit board is a work of art and all of the components and wiring are of the highest quality.

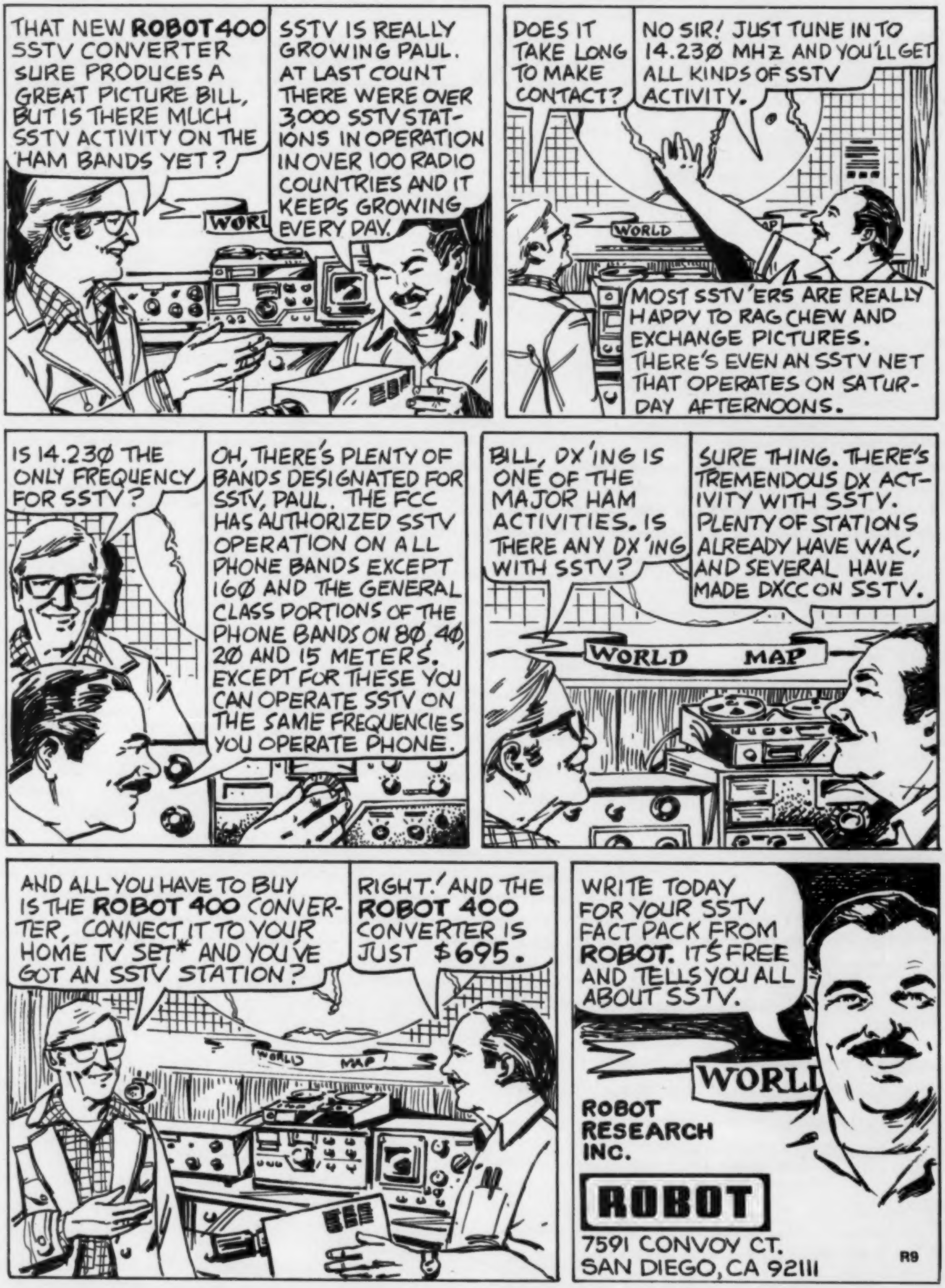
The front panel control layout is well engineered with a largely functional grouping of controls. Power is controlled by a single central toggle switch with an LED indicator. The unit can be ordered to operate on 115 or 230 V ac at 50 or 60 Hz. Line voltage and frequency must be specified when ordering since there is some change in clocking and associated circuits when operated at 60 Hz as opposed to 50 Hz. Input to the main memory for display is selected by a front panel rotary switch (MEMORY INPUT). Options include GRAY SCALE, CAMERA (fast scan CCTV), RECEIVER, TAPE, and OTHER (SSTV sources such as cameras, flying spot scanners, keyboards, or alternate receivers or recorders). A MEMORY INPUT toggle switch permits continuous display of new pictures or freezing the existing picture in memory. BRIGHTNESS and CONTRAST controls are provided to adjust these values for SSTV display. Another control (WIDTH) adjusts the internal oscillator to accommodate pictures from 60 Hz and 50 Hz sources.

The remaining controls function on the transmit side of the SSTV operations. A TRANSMIT SELECT rotary switch controls the signals routed to the transmitter and tape recorder. These options include VOICE (station microphone audio in transmit and unprocessed audio from the receiver when recording), MEMORY (the contents of the main memory), REVERSE (a black to white reversal of the image in the memory which is handy for special effects), TAPE (pictures previously recorded on tape), and OTHER (other SSTV sources which can be transmitted or recorded without going through the 400s digital memory). A DISPLAY toggle switch permits real time viewing of the digitized output of the fast scan camera or viewing of the memory contents. A SNATCH push-button permits manual updating of the fast scan camera image in memory. The fast scan snatch function has its own front panel CONTRAST and BRIGHTNESS controls so that good video swing can be obtained from cameras whose fast scan output may be of marginal quality.

The rear panel has the ac cord and circuit breaker plus the multitude of jacks required for interconnecting the 400 with the other equipment. Two of the jacks are BNCs (input from the CCTV camera and output to the video monitor) and Robot supplies a 5 foot length of coax with BNCs on each end for connection between the 400 and the monitor. Two jacks are 3 conductor phone jacks, one of which is for the station microphone and the other for a cable between the 400 and the audio input to the transmitter. Robot supplies a cable for the latter and you simply have to equip your microphone with a 3 conductor ¼" plug. Normal microphone PTT functions are looped through the 400. The microphone provides the audio to the transmitter in the VOICE position of the TRANSMIT SELECT switch while other positions select video sources as described previously. A front panel LED indicator comes on when video has been selected and a gain control on the rear apron lets you set the video output from the 400 to a level compatible with your transmitter audio input, eliminating the need to alter the transmitter audio gain. This gain control only functions when the 400 is generating the SSTV signal from its memory. Outside sources such as tape or other SSTV cameras must have their levels adjusted at the source. All of the other jacks on the rear apron are standard phono jacks for the receiver output, input from other sources, and input and output from the tape recorders). Robot supplies a cable for connection to the receiver and all other interconnections can be made with suitable shielded hi-fi cables.

Circuit Description

There is no way that a few well-chosen words or paragraphs are going to do justice to a complex circuit such as the 400 or any other scan converter for that matter. All I will attempt here is to hit some of the high points in describing the operation of the unit. The heart of the 400 is its digital memory. The memory is composed of 16 UPD411D random access memory (RAM) chips, each with a capacity of 4092 bits


THAT NEW ROBOT 400 SSTV CONVERTER SURE PRODUCES A GREAT PICTURE BILL, BUT IS THERE MUCH SSTV ACTIVITY ON THE HAM BANDS YET?
SSTV IS REALLY GROWING PAUL. AT LAST COUNT THERE WERE OVER 3,000 SSTV STATIONS IN OPERATION IN OVER 100 RADIO COUNTRIES AND IT KEEPS GROWING EVERY DAY.
WORL
DOES IT TAKE LONG TO MAKE CONTACT?
NO SIR! JUST TUNE IN TO 14.230 MHZ AND YOU'LL GET ALL KINDS OF SSTV ACTIVITY.
WORLD
MAP
MOST SSTV'ERS ARE REALLY HAPPY TO RAG CHEW AND EXCHANGE PICTURES. THERE'S EVEN AN SSTV NET THAT OPERATES ON SATURDAY AFTERNOONS.
IS 14.230 THE ONLY FREQUENCY FOR SSTV?
OH, THERE'S PLENTY OF BANDS DESIGNATED FOR SSTV, PAUL. THE FCC HAS AUTHORIZED SSTV OPERATION ON ALL PHONE BANDS EXCEPT 160 AND THE GENERAL CLASS PORTIONS OF THE PHONE BANDS ON 80, 40, 20 AND 15 METERS. EXCEPT FOR THESE YOU CAN OPERATE SSTV ON THE SAME FREQUENCIES YOU OPERATE PHONE.
BILL, DX'ING IS ONE OF THE MAJOR HAM ACTIVITIES. IS THERE ANY DX'ING WITH SSTV?
SURE THING. THERE'S TREMENDOUS DX ACTIVITY WITH SSTV. PLENTY OF STATIONS ALREADY HAVE WAC, AND SEVERAL HAVE MADE DXCC ON SSTV.
WORLD MAP
AND ALL YOU HAVE TO BUY IS THE ROBOT 400 CONVERTER, CONNECT IT TO YOUR HOME TV SET* AND YOU'VE GOT AN SSTV STATION?
RIGHT! AND THE ROBOT 400 CONVERTER IS JUST $695.
WORLD MAP
WRITE TODAY FOR YOUR SSTV FACT PACK FROM ROBOT. IT'S FREE AND TELLS YOU ALL ABOUT SSTV.
WORLD
ROBOT RESEARCH INC.
ROBOT
7591 CONVOY CT.
SAN DIEGO, CA 92111
R9

* The Robot 400 Converter can be connected to the antenna terminal of a home TV set by means of the Robot RF Adapter Kit option for $25.

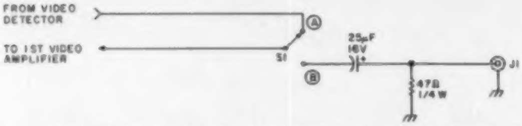


Fig. 3. Modification of a small solid state TV set for use as a video monitor. The set must *be transformer operated with a grounded chassis to avoid a shock hazard and possible damage to the 400. J1 is a BNC jack and S1 is an SPDT toggle switch. Position A is for normal TV viewing, while in B the set functions as a video monitor. Similar conversions can be implemented in a variety of sets. The one I use is a Sony TV-770. In the 770, the line from the detector to the first video amp is a small piece of gray coax with a brown stripe. The coax is disconnected from the video board and soldered to the switch contacts (A). A small piece of subminiature coax is routed from the common switch lug back to the disconnect point on the video board. In converting the 770 or any other set, you should obtain a schematic or, better yet, a Sams Photo-facts booklet for the set prior to surgery. All of the SSTV pictures for this article were taken using the TV-770 and it does an excellent job.*

(4K). These are dynamic memories and hence require a refresh cycle to retain their stored data. The 400 circuitry is set up so that the refresh cycling is provided in conjunction with the fast scan read operation which is going on continuously as long as power is applied to the 400.

Processing of SSTV signals is fairly conventional with op amps employed as limiters and active filters to provide the video waveform and sync signals to appropriate Schmitt triggers interfacing the SSTV sync signals to system logic levels. Incoming SSTV clocking is derived from a free running oscillator whose frequency is set by the WIDTH control on the front panel. The oscillator is triggered by the horizontal sync pulses derived from the incoming SSTV signal, thus locking the clock to the incoming video format. The A/D converter is composed of a series of 711 voltage comparators. The use of 1% resistors in the A/D circuits assures a precise A/D conversion. Initial A/D conversion is to gray code with onboard conversion from gray code to binary.

Fast scan clocking and sync and all internal slow scan clocking from memory is referenced to an onboard crystal oscillator assuring rock stable clocking at all points in the system. The RAM memory is multiplexed in the 400 to achieve the speed required for fast scan display. The D/A conversion is accomplished with a 7486 and a series of 1% weighting resistors with several discrete transistors providing the interface to the external video monitor.

When snatching video from a fast scan source, the fast scan sync pulses from the source lock up an oscillator which serves as the reference for clocking the fast scan frame into memory. Readout from memory in the slow scan format is achieved with a custom VCO chip factory set for the 1200 Hz sync and 1500 and 2300 Hz black and white levels. Active devices are used throughout the 400 for digital and analog switching functions, thus vastly simplifying the interconnections between the board and the 400 controls and I/O ports.

The 400 manual provides a complete schematic and quite a detailed circuit description, and your ability to understand the inner workings of the beast should largely be limited only by your effort in studying the manual. Should you want to do a little digital design work yourself, the 400 is a marvelous store of interesting design approaches.

Performance

Hooking up the 400 to perform all of its tricks will require a video monitor and a standard CCTV camera. Suitable video monitors can be purchased from Robot or CCTV outlets and you can expect to pay between $250 and $300 for a suitable monitor going this route. Excellent monitors can often be obtained at very good prices from computer stores and at the larger hamfests. It is also possible to modify a standard TV set for use as a monitor but *you must not use a set with a hot chassis.* Such a set can be dangerous to your health and, what is worse, will almost certainly damage the 400. The set shown in Fig. 1 is a Sony TV-770 converted to video monitor service as shown in Fig. 3. A small screen monitor is a must and you should not consider a screen size larger than 9" unless you plan to use it strictly for large group demonstrations. Screen sizes between 5 and 8" are ideal for normal viewing distances and the TV-770 is just about ideal and costs about $140 maximum. If you absolutely must use a set with a *hot* chassis, then you should go the rf route, converting the 400 video output to an rf signal for viewing on an unused VHF channel. Robot markets a board ($25) for this purpose. The rf route is the only safe approach to using a hot chassis set since the manufacturers have taken great pains to isolate the antenna terminals from the dc circuitry. Personally, I would only resort to rf display for occasional use in large demonstrations where it is feasible to use any large screen set that might be available.

CCTV cameras can also be purchased from Robot, CCTV outlets, or at the larger hamfests. As noted later, almost any camera with standard video (not rf) output can be used. Bargains in used cameras can usually be obtained from CCTV outlets, security operations, or community TV companies.

An experienced slow scanner can have the 400 displaying pictures within ten minutes after the package arrives at the door, but I would suggest that you spend some time with the instruction manual as it has an excellent description of the function of the various controls and should answer all of your questions about interconnection with your own equipment. In terms of all of its functions, the unit I received worked right out of the box, but I did notice an apparent problem with a lack of sensitivity at the SSTV inputs (receiver, tape, and SSTV sources). This was particularly noticeable when the level from external SSTV sources was reduced for proper transmitter operation, for at the proper output levels, the 400 would not lock up reliably. The specifications indicated that the SSTV inputs should limit with a signal level of 20 mV, but a quick check showed that this was not the case. A call to Robot revealed that this had been a problem with some of their first production units and that current production models had some resistor changes that eliminated the problem. Substitution of the new values immediately brought my unit up to specs and it is unlikely to be a problem with any 400s other than the first sets that left the factory.

The 400 was very easy to set up for proper video display and has performed flawlessly. Noise immunity is the equal of the best home brew circuits I have used, and the unit does an excellent job even under current band conditions. The major feature I felt was lacking was a tuning indicator to assure proper carrier insertion when tuning the HF sideband gear. If the pictures you are receiving have normal contrast, tuning

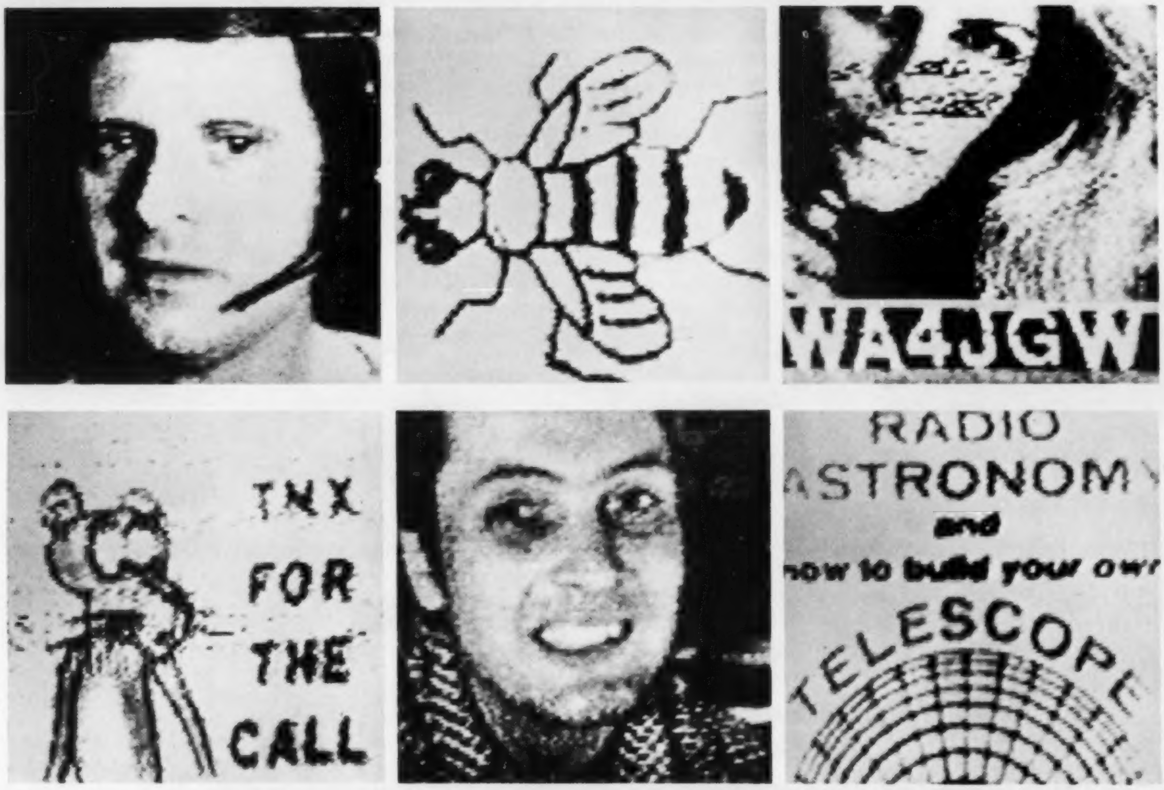


Fig. 4. A collection of miscellaneous SSTV pictures logged on 20 meters and displayed on the Robot 400. Only a simple dipole was used for the antenna system and, despite the current state of the band, the 400 delivered excellent pictures. Picture quality in terms of sharpness and contrast is limited only by the care with which pictures are set up at the transmitting end. If you are willing to alter the receive BRIGHTNESS and CONTRAST controls from their proper settings, even pictures of poor quality can be improved considerably. I tend not to alter these controls once they are properly set, as I want to be constantly in a position to realistically evaluate picture quality, and the replay (from the 400 memory) of a station's pictures can do wonders in getting the operator at the other end to set the pictures up more carefully!

is quite easy — you simply tune for maximum contrast and you will be right on the money. Unfortunately, there are still too many operators who are grinding out pictures that are low in contrast, and these can result in errors in tuning as you attempt to optimize video display. An LED tuning indicator can easily be added to the 400 (see the *73 SSTV Handbook* for circuit possibilities) if you desire. The lack of a tuning indicator does not really detract from the 400's performance — I just like the convenience they provide. A number of representative pictures are included to show you what can be expected under normal band conditions.

Tape display is extremely reliable even with cassette recorders. Despite Robot's caution to use recorders with good wow and flutter specifications, a number of 10 year old tapes — recorded on a battery operated reel-to-reel recorder — actually displayed quite nicely. Given the over-the-air performance, one might expect that display of local SSTV sources would present no problems, and this is definitely the case. A variety of SSTV cameras, flying spot scanners, and an SSTV keyboard were tried with excellent results being obtained in all cases.

Experienced slow scanners may be curious to know how the 400 shapes up in the contouring department since it does not employ line averaging or psuedo-random noise techniques. The key here is the use of a small screen monitor. With the proper monitor display, contouring has little or no subjective impact when the pictures have a normal contrast range. Contouring will always be visible with 16 gray scale shades if you take the trouble to look for it, but none of the people who have seen pictures on my 400 have even mentioned the effect. Contouring is more easily noticed if there are extensive areas of the picture with little or no detail, such as the background of an ID sign that is not evenly lighted, or in pictures with too little contrast. In the latter case, you are attempting to display a picture using too few gray scale steps and the effect is that of using a system with fewer gray shades.

One operational convenience of the 400 that I did not anticipate was the case in making demonstration tapes. I usually record pictures off the air using a cassette tape deck. Such tapes typically have many frames marred by QRM and intervals of conversation. When such a tape is reviewed, you can freeze a particularly good frame in the memory, remove the tape from the machine, and substitute your demo cassette. You can then record two or three frames from the 400 memory, replace the tape again, and begin looking for other good frames. A single small cassette can thus contain the best pictures from a large number of tapes, resulting in an excellent record of your contacts as well as a good tape to play at radio clubs or hamfests to generate a little interest in SSTV. Many tape decks do not incorporate automatic level control, and these are often tedious to use since you have to ride the gain control to keep a reasonably constant signal level when recording pictures off the air. This problem can be eliminated if the transmit select switch is placed in the memory position during recording. You are thus recording from the 400 memory and the signal will have a constant amplitude regardless of the input variations in the incoming SSTV signal. The only disadvantage of this technique is that you do not preserve the audio commentary. If the voice signal is desirable, you can simply switch the transmit select to voice when pictures are not coming in, but you will have to ride the gain!

The 400 does an equally good job in terms of all of its transmit functions as well. In common with past Robot equipment, the 400 handles the interconnection of the tape recorder and other SSTV signal sources to the transmitter with the ability to select either voice or a video source. Where it really shines, however, is in frame grabbing from fast scan sources such as a CCTV camera. With the display switch in the camera position, you view the fast scan picture in real time, but in its digitized form. The brightness and contrast controls for the snatch function let you compensate quite nicely for poorer than average subjects or flat camera output. The signal you see is precisely what will be stored in memory, so setup is no problem. With the memory input toggle switch in the continuous position, a new fast scan frame is snatched at the start of each SSTV frame. In the hold position, frame snatch is manually controlled with a front panel pushbutton. This is particularly nice if the camera is in an inconvenient position as you can face the camera, leer, and press the button, and then return to scratching or whatever else you do when the camera is not "live." A variety of cameras were used with the 400, ranging from some excellent new cameras with built-in viewfinders to an old Dage and several ancient home brew cameras. If you take the trouble to bring the broadcast video out of a TV set, you can also frame grab from that source. Broadcast video is excellent for test setups and demonstrations since it invariably has excellent resolution and contrast, but it is questionable whether you should transmit it on the air. I have seen quite a bit of snatched broadcast material on the air in the last few weeks, but it is worth noting that technically the practice is illegal since it involves the relay of material from the broadcast service via the amateur service. In any case, the material from soaps or afternoon game shows hardly raises the quality of 20 meter operations! The 400 will also frame grab nicely from a video tape recorder if you are lucky enough to have one of those goodies to play with. The frame grab capability of the 400 is simply so convenient that I will gradually be phasing much of my slide pickup and special effects cameras from SSTV to fast scan format, probably with a common sync source so that all can be tied in effectively with my fast scan operations on 440 MHz. The 400 has some interesting possibilities here since fast scan video from 440 can be frame grabbed and relayed via SSTV on 2 meters to stations that are outside of the normal ATV range in our area.

Summary

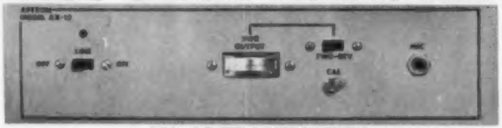
The components, workmanship, and performance of the 400 are simply first rate, and it is my own personal opinion that it represents the finest piece of commercial SSTV equipment on the market today. You can build a somewhat more versatile scan converter than the 400 and you would probably be able to do it for somewhat less than the $695 price tag of the Robot gear. Such an effort, however, would be a major project – probably one of the most complex projects that amateurs can undertake these days – and a careful evaluation would be required to determine if the small margin in performance that you might obtain would be worth the effort. The 400 is an excellent package at a good price for the value received. Its performance is such that I have no plans to put together a conventional scan converter for SSTV. I am in the process of adding additional memory and video circuits to accommodate real time color display, but any attempt to duplicate the features of the 400 itself is simply not worth the effort unless you enjoy building for its own sake.

Once you have used a digital scan converter, you will simply not be satisfied with a conventional monitor. Digital scan conversion is going to be responsible for another burst of growth in SSTV and a great deal of that potential growth will be chalked up courtesy of Robot and their 400. The unit is well-engineered and can be expected to perform well in the hands of a neophyte or an experienced operator. By all means seek one out for a demonstration – it will be worth the effort. ■

References

[1] Steber, George R., 1975, "SSTV to Fast Scan Converter." *QST*: Part I in March issue, Part II in May issue. This article is must reading for anyone interested in digital scan conversion. It not only describes an excellent scan converter (using 1024 bit shift registers), but it also has excellent sections on the theory of scan conversion and some approaches to image processing.

FAST SCAN AMATEUR TELEVISION EQUIPMENT



AX–10 TRANSMITTER

AM–1A RCVR MODEM

BROADCAST
QUALITY
PERFORMANCE

Aptron Laboratories
Box 323 Bloomington IN 47401

SOLID
STATE

A6

Joe Magee WA5ACA
P.O. Box 5444
Austin TX 78763

Bounceless TT Decoder

-- a single chip does it!

Do you remember the first time you went to the doctor and your mother told you that it wasn't going to hurt? Well, that trick only worked once, didn't it? I had much the same feeling the first time I tried to interface some TTL logic to the outputs of 567 decoders. Nobody told me that those nice decoders take several milliseconds to stabilize and, as we all know, TTL will count each and every little glitch just as if it were the real thing.

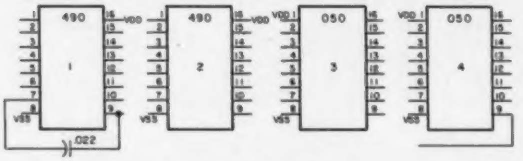

490
1
490
2
050
3
050
4
VDD
VSS
.022

Fig. 1. Debouncer.

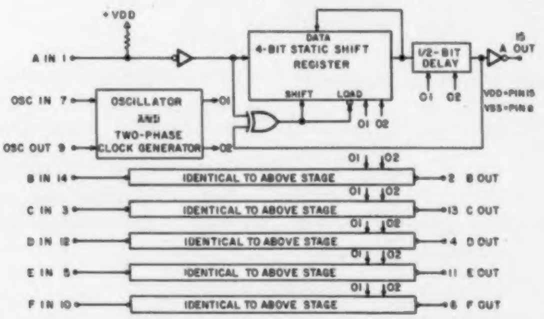

+VDD
A IN 1
DATA
4-BIT STATIC SHIFT REGISTER
1/2-BIT DELAY
15 A OUT
OSC IN 7
OSCILLATOR AND TWO-PHASE CLOCK GENERATOR
OSC OUT 9
SHIFT
LOAD
VDD=PIN 16
VSS=PIN 8
B IN 14
IDENTICAL TO ABOVE STAGE
2 B OUT
C IN 3
13 C OUT
D IN 12
4 D OUT
E IN 5
11 E OUT
F IN 10
6 F OUT

Fig. 2. Block diagram.

So, how do you debounce seven 567s without building some kind of one-shot or flip-flop for each one? Easy, especially if you have a Motorola CMOS data book. Look in it for an MC14490 and you will discover that it is a hex contact debouncer. How about that — 6 debouncers in one chip! Fantastic. How does it work? The same — fantastic!

Fig. 1 is the schematic of a circuit I built for our repeater. The 567s go directly into TTL gates to generate 12 data lines, 0-9, * and #. The gates faithfully transmit all the glitches supplied by the decoders. Reviewing the operation of the 14490s (Figs. 2 and 3) shows that basically all it does is wait until the signal on its input has been stable for four clock periods before the output will change to be the same as an input. Another handy feature is that by putting a single capacitor between two pins, a clock oscillator is formed. This same oscillator can be used to clock several chips. Interfacing the inputs of an MC14490 to a switch or TTL output is easy because pull-up resistors are included right on the chip. This means unused inputs can be left open, unlike normal CMOS inputs. But that is not all. Each output of a 14490 is capable of driving one TTL load. In our system, we decided that a 20 ms delay was desirable as it would eliminate all glitches from the 567s and tend to eliminate false noise decoding. The 0.01 capacitor results in an oscillator frequency of approximately 200 Hz, which gives four clock pulses every 20 ms.

The MC14050s are included to give enough current to drive the subsequent TTL logic used to decode various numbers and sequences we don't want dialed by our autopatch.

So, armed with MC14490s, no one should get stung by 567s, switches, or anything else that generates similar TTL-eating glitches. ■

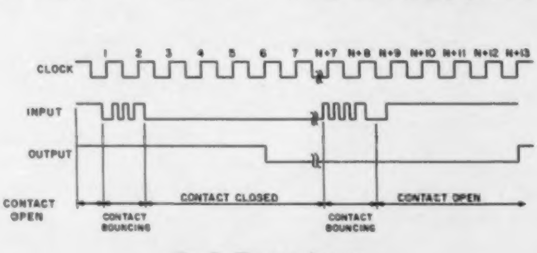

CLOCK
1
2
3
4
5
6
7
N+7
N+8
N+9
N+10
N+11
N+12
N+13
INPUT
OUTPUT
CONTACT OPEN
CONTACT BOUNCING
CONTACT CLOSED
CONTACT BOUNCING
CONTACT OPEN

Fig. 3. Timing diagram.

Hams Profit From CB

-- how to set up a service center

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Okay, most of the communicating community agrees – if somewhat grudgingly – that Citizens Band has a place in the scheme of things and even serves its user quite well at times. What most non-CB users and new CB users don't know is that there is a definite shortage of qualified CB technicians – and the shortage gets more acute each day. This is not to say that there aren't a lot of would-be CB repairmen. There are. The shortage is of *licensed* qualified technicians.

Under current FCC Rules and Regulations, only the holders of First or Second Class Radiotelephone operator's licenses can make repairs which can affect the legal operation of CB transceivers. That license isn't all that easy to get, either.

While there is no code test required for commercial phone tickets, there is a very stiff testing procedure. In order to qualify for a Third Class license – little more than a glorified Restricted Operator's Permit – elements I and II must be passed with a score of 70 or better. That is duck soup. These two elements are only to check the applicant's familiarity with basic FCC rules and proper operating procedures. Unfortunately, a Third Class license does not entitle the holder to do anything other than *operate* certain classes of radios – which are not germane to this article.

In order to qualify for a Second Class license, element III must be passed in addition to elements I and II. This is where it gets binding.

Element III is 2 to 4 hours of the hardest multiple choice questions that you can imagine. The closest parallel to it in amateur service is the Extra Class exam. The applicant who goes to the nearest FCC office had damn well better be prepared for element III or he is going to find himself winning only a Third (not much of a consolation prize) and facing a 60 day wait before he gets to try again.

If, however, he feels confident and really well prepared, he can add another buck and take element IV as well. The test applicant who passes elements I through IV, inclusive, gets to have his name typed on a beautiful, suitable-for-framing, First Class Radiotelephone operator's license (Fig. 1). Actually, element III is the hard one. Element IV only checks the applicant a little more closely in areas mostly pertaining to commercial broadcast stations.

For a couple more dollars, the passing applicant gets a wallet-sized verification card which attests to his having passed the necessary tests.

If you only want to work on non-commerical transmitters – CB, marine, land mobile, etc. – or smaller broadcast stations, a Second Class license is all that is required. However, there is a certain satisfaction in being "First Class" even if you never intend to exercise the additional privileges. And it just might happen that one of the local radio stations needs a part-time chief engineer. For an extra dollar, there is nothing to lose by trying for it.

If an amateur is pretty well up on his theory – General Class or higher – learning the extra knowledge required to pass the commercial tests will be a simple matter. The only additional materials that a commercial aspirant will need to borrow or buy are study guides or outlines for elements I through IV. Many local libraries have such volumes – which are published by TAB, Sams, Hayden, and others – on the shelves to lend. If your library doesn't have one or the one it has is several years old, either check in a larger bookstore or newsstand or watch for ads in electronics publications such as *73*.

The study guides that you used for brushing up on theory before taking the General test and the *ARRL Radio Amateur's Handbook* are excellent for taking a different approach on a point which gives you trouble. For more than one electronics hobbyist, that First or Second Class ticket has been the passport into a whole new career. If the holder of a commercial license has any ability at all to troubleshoot and repair electronic equipment, he can always make a living at it. Maybe he will have to move from where he is, and maybe he won't always do just what he wants at the pay he feels that he deserves, but he will always eat.

Attitude is Important

Just because a person has a crisp new First or Second ticket on his wall doesn't mean that those "chicken banders" are going to beat a path to his door. He is going to have to let them know that he is interested in seeing that their equipment is working properly and that, as an amateur, he doesn't look down on them. As is the case in amateur radio, operators of CB equipment have many different vocations and often are very, very good in their particular fields. A case in point is a recently overheard

QSO on 40 meters where the ham was remarking that the friend in the shack with him had a trenching machine and was digging the footings for the tower and guy anchors for the tower which the ham was in the process of building. That is the kind of friend to have. Dig?

As CBers learn of a new repair service in the area, word travels quickly. The bad word travels fastest. The good word travels farthest.

In almost every town, there is at least one CB dealer selling CB gear without having any real service department. A polite call on him to ask for his business and assure him that you are not interested in competing with him may be the beginning of a profitable relationship. The current rash of discounting takes a lot of profit out of the selling part of the business, anyway – you can make more on an installation than he does on the sale.

Taking all of your business from various dealers has at least one real advantage. If you deal strictly with dealers, you spend little time just talking to retain customers. On the other hand, the dealers may not provide you with as much business as you would like to have.

If the latter is the case, you should spend a few bucks taking out ads in CB club papers or local newspapers. If you plan your ads carefully and schedule them often enough to keep your service in the eyes of those you wish to serve, a few dollars will do a lot of good.

One fringe benefit of dealing directly with your customers rather than through dealers is the additional exposure that you can give amateur radio. (It's also a good way to move that older gear that you wish to replace with more sophisticated equipment.) Each year thousands of CBers will decide to get further into radio. What better way to spark this interest than offering to give demonstrations – you can even schedule a group to watch – some slow weekend?

A positive, non-condescending attitude will go a long way towards making friends and regular customers among local CBers.

Equipping Your Shop

If you intend to do any large amount of CB repairs, you will need to have some kind of shop. The shop can be your shack, if space and the XYL permit. However, a garage or small outbuilding is much better.

If you have a shop isolated as much as possible from the house, you have a more peaceful atmosphere in which to work; your customers won't be as likely to disturb your family or vice versa. If space at home doesn't permit a shop or zoning restrictions preclude it, you have at least two alternatives.

In most areas, there are small shop spaces for rent for 50 to 100 dollars per month. The drawback is that the locations are usually less than choice. If you are not geared for walk-in trade and keep erratic hours, this can be an advantage, especially if dealers provide the bulk of your business.

Another possibility is that one of your dealers may have a small back room that he will let you use. This is a little sticky, though, if you are doing work for more than one dealer. In any event, these are just ideas. If you have a friend who wants to work with you, he may have another alternative.

If you are really an active experimenter, you may already have much of the test equipment that you will need for CB service. Even if you have to start from scratch, you can do it for less than you might think. A lot depends on your resourcefulness. A successful dealer really hungry for service just might be willing to help you acquire what you need.

What do you really need for CB service?

Actually, $5000 will just about make it – plus parts inventory. However, let's assume that you *don't* have $5000 to invest in service equipment at this stage of the game.

Frequency Measuring Equipment

After the small tools and diddlesticks, soldering irons and wrenches, screwdrivers and drills, the first item to acquire is some device for measuring frequency. A Cushman or H-P or Lampkin would be nice, but none of these is a necessity. Among others, Heath makes several counters which work just fine for CB.

An older heterodyne frequency meter can also be used. All that is required is that transmitters tested meet or exceed FCC requirements. At CB frequencies, the tolerance is plus or minus 50 parts per million. However, only a poor technician or one faced with an unusual situation would ever pass a piece of CB equipment which was barely within the law. Most modern CB transceivers are selective enough now that a station anywhere close to the legal limit would sound distorted and range would suffer.

Signal Generator

Unfortunately, many small shops try to cut corners with signal generating equipment. When this is the case, the technician spends much longer than he should tuning a receiver. Rock-solid signal generating equipment capable of attenuation to below one

The United States of America

FEDERAL COMMUNICATIONS COMMISSION

RADIO TELEPHONE OPERATOR LICENSE

FIRST CLASS

(General Radiotelephone Certificate)

This certifies that

Anchorage, Alaska April 13, 1972

April 13, 1977

Anchorage, Alaska

Engineer in Charge.

Federal Communications Commission

John E. Phillips,

Asst. Engineer in Charge.

Ben F. Waple

NOT VALID UNTIL SIGNED

Fig. 1. An FCC First or Second Class Radiotelephone license is well worth the trouble it takes to get it.

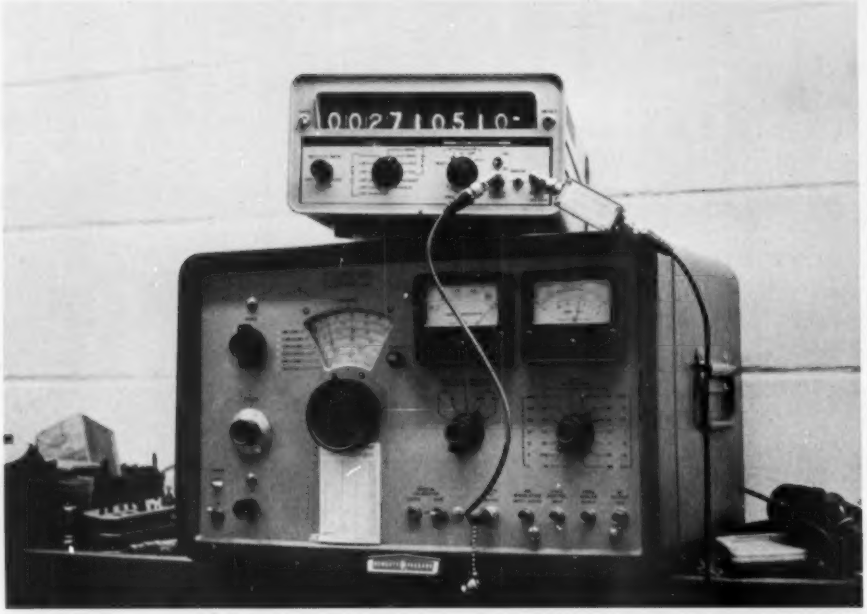

Fig. 2. Stable signal generating and frequency measuring equipment is essential for profitable CB service. Many hams already have such equipment sitting idle on their bench.

microvolt with adjustable amplitude modulation is hard to come by on a budget (Fig. 2).

In order to do the job with less equipment, you may have to constantly check the frequency output against your shop counter or frequency meter. This takes time and, if overlooked, can mean that the whole procedure must be redone. One technician solved the problem with an old CB transceiver.

This particular unit had good oscillators, but the power stages had been fried by reversing the power polarity and overfusing. The buffer stage was still good in the transmitter and the audio driver still worked.

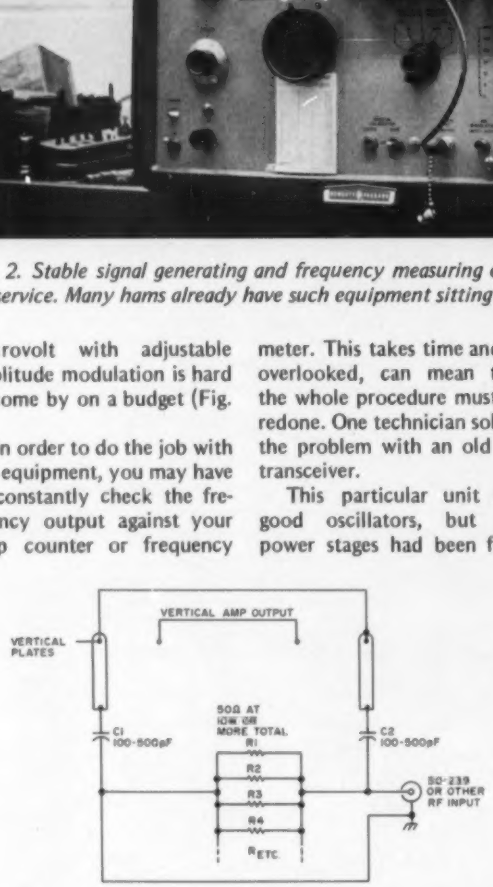

Fig. 3. A simple modification will permit practically any scope to directly handle 27 MHz transmitter output. A visual indication of modulated rf output can tell a technician not only how much modulation is present, but also how much distortion is present as well. On some scopes, it may be necessary to build the termination/coupling network so that it may be removed from the circuit when not in use. Care should be taken to see that the vertical amplifiers are not fed excessive levels of rf; average CB units will have 13-15 volts rms of rf across 50 Ohm load. Resistors should be carbon — not wirewound — paralleled as necessary for 50-52 Ohms total with a power rating of at least 10 Watts. Values of C1 and C2 should be adjusted for adequate deflection with minimum loading or swr on input.

He stripped out all of the damaged circuitry and coupled the buffer output to the antenna terminal. He then jiggered around with the driver in the audio section until he got feedback on it. This tone was adjusted, by varying the amount of feedback capacitance, and coupled through a pot to the buffer stage in the transmitter. The push-to-talk switch was replaced with a toggle switch, and he had a reasonably useful crystal generator with variable modulation. There were only two drawbacks.

Some of the crystals were off-frequency several hundred Hertz and the rf spray from the unit was terrific. Our hero merely disconnected the offending crystals and installed the unit in another chassis. When the seams were sealed with aluminum tape, spray was reduced to a tolerable level. A homemade attenuator between the original chassis and the outer chassis allowed him to reduce the output to close to one microvolt.

As units vary considerably, and this particular one is reposing in a junk pile somewhere, no specifics are offered for such modification. The item was mentioned strictly for its inspirational value. If you don't think that the idea is worth toying with, though, just try to price a commercial piece of equipment designed to do the same thing.

Scope

There is probably more controversy regarding the use of a scope than there is about all of the other test equipment combined. Some technicians use a scope for practically every test that they make, and constantly monitor the performance of one thing or the other with it. Other technicians seldom use a scope except for audio work. Most of us take the middle road and use the scope anytime that we need to compare audio or rf voltages and need the frequency discrimination provided by the scope's adjustable sweep rate.

Most inexpensive scopes share two disadvantages. They are grossly insensitive at high frequencies, and input impedance is so low that many small-signal circuits are swamped by the probe. At high frequencies, low capacitance probes usually lower overall vertical gain even more than do regular probes.

Obviously, one solution would be to get a 30 MHz scope. Unfortunately, the price of such exotic tools is quite high, even when they are surplus. Another solution is to buy a scope with as high a frequency response as the budget will stand and use it wherever possible.

For CB work, the wisest choice is probably to opt for an inexpensive 5 MHz scope and add blocking caps and a dummy load to the vertical deflection plates for viewing of modulation patterns. See

Fig. 3.

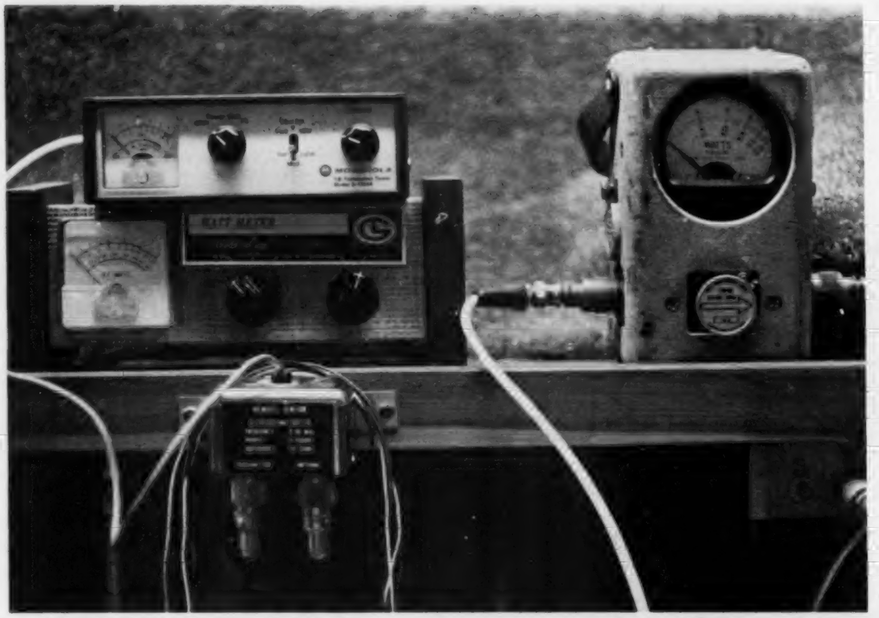

Fig. 4. FCC Rules require that CB rf output not exceed 4 Watts. These instruments measure reflected power or swr, as well as forward power.

Electronic Voltmeters and Multimeters

Each CB shop needs at least one high impedance electronic voltmeter and at least one small, tough VOM for the abuse which such instruments always get. The old H-P 410B with the UHF rf probe is always a good choice for the budget bench. Not only are these instruments accurate, but they are also fairly cheap now.

With the whole world racing to become metric and digital, there are still some old ways that are better. Maybe the digital meters *are* handier for most purposes, but it is hard to beat an analog meter when it is being used to monitor a tuning response. Perhaps someone would prefer to dip a final with a digital meter, but most people prefer the smoother swing of a needle. The point is simply that brand new digital equipment is not indispensable.

Swr Meters and Wattmeters

A well-equipped ham shack has some means of measuring rf output power and either vswr or reflected power (Fig. 4). Legal CB transceivers, however, operate at very low power levels compared to most amateur equipment. This being the case, you may have to purchase special test instruments for CB service. If there is a Bird in the house, all that is necessary is an element for high accuracy at CB frequencies. If not, one of the multi-purpose CB transceiver testers on the market will do just fine.

The scope dummy load mentioned earlier can be calibrated against a known reference to handle bench checks, and a separate swr meter will handle the tests into operating antennas. The swr meters are not expensive and usually are quite reliable.

Bench Power Supply

Most of the transceivers which you will service are mobile 12 V dc units which draw about 1 to 2 Amperes at 13.8 V dc. A regulated and metered bench supply is absolutely essential for profitable CB service. In lieu of a neatly packaged bench supply, a battery with a well-filtered charger and a voltmeter/ammeter readout in the bench panel (Fig. 5) works very well. If you like to build and design, add switches to control charging, a circuit breaker to protect the meter and equipment being serviced, and as many status lights as desired.

A good bench safety feature is a panic button which will shut down all ac line power at once. If the ac switch — which can be an inexpensive wall panel circuit breaker — and the dc switch are mounted close together, you can kill everything instantly when you get smoke — as you surely will sooner or later.

Antennas, Library, Jumpers, and Misc.

This last category is sort of a catchall. But watch it. The shop antennas, technical library, and various cables for connecting this to that can entail a considerable investment. However, to attempt to service CB equipment without them is to turn what could be a good part-time business into an expensive hobby.

If you intend to offer installations — and you should as part of the service — you can expect to lay out more bucks for tools. Don't try to cut corners with your hand tool budget. There is nothing in this world more frustrating than having a

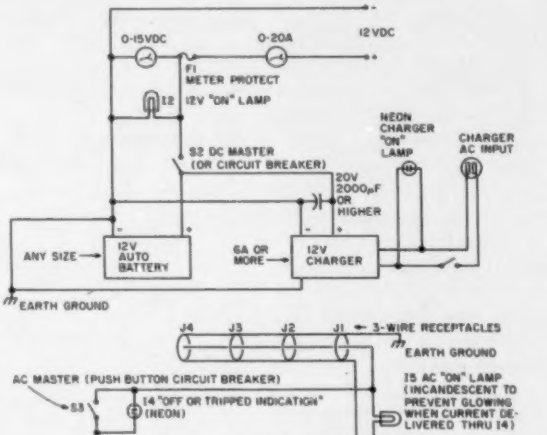
0-15VDC
0-20A
12VDC
F1
METER PROTECT
I2
12V "ON" LAMP
NEON CHARGER "ON" LAMP
CHARGER AC INPUT
S2 DC MASTER (OR CIRCUIT BREAKER)
20V 2000μF OR HIGHER
ANY SIZE
12V AUTO BATTERY
6A OR MORE
12V CHARGER
EARTH GROUND
J4
J3
J2
J1
3-WIRE RECEPTACLES
EARTH GROUND
AC MASTER (PUSH BUTTON CIRCUIT BREAKER)
S3
I4 "OFF OR TRIPPED INDICATION" (NEON)
I5 AC "ON" LAMP (INCANDESCENT TO PREVENT GLOWING WHEN CURRENT DELIVERED THRU I4)
I3 AC "LINE HOT" INDICATOR (NEON)
EARTH GROUND
THREE WIRE AC LINE PLUG (SHOULD BE ON SEPARATE 20A CIRCUIT)

Fig. 5. Simplified schematic of bench power supply. This battery supply provides plenty of stable, well-filtered dc power. While few CB units use more than 2 Amperes at 13.8 V dc, the ambitious technician may soon find himself expanding into other fields. I4 may be omitted if it is desired to remove all leakage.

cheap tool break right in the middle of a job. If the customer is looking on, it's even worse – it's unprofessional as hell.

Parts Inventory

Most CB units are combinations of very common parts – resistors, caps, diodes, transistors, etc. – and extremely rare parts – channel selector switches, crystals (sometimes impossible to get even on new units), and special chassis parts. In most cases, the manufacturers can supply you with the parts unique to their respective units – for a price and after a time. In other cases, the time and expense involved may make the job economically unfeasible.

There is no pat solution to the parts problem. You may find that it is worthwhile for you to accumulate a few junkers of assorted brands. Some parts may be available from a "manufacturer" who markets a unit nearly identical to the one on your bench but under another name. This is where your most important tool comes into play – your brain.

No matter how limited your budget or cramped your quarters, you always have room to keep your brain. This handy item can often take the place of a whole shelf of test equipment. Remember that most problems can be diagnosed without taking the unit out of its case – if you only know what symptoms to look for and what they mean when you have them. This same tool can pull your fat out of the fire when you remember that the unit on the bench is just like the one that you have in the junk pile except for the label on the front.

One way to take care of this tool and even improve its performance is to keep a notebook on every job that you do. After a few months, the data begins to add up to increased profits. ■

Patch Up Your 101

- - simple mod for the HW-101

Edward W. Robinson K7VUA
31033 42nd Ave. S.
Auburn WA 98002

I had a dream for several years to own the Heath SB-100 – then the SB-101 – then the 102, but I never could quite get: a) the XYL to buy the deal; and/or b) the green stuff together to swing the deal! Finally, I realized that second best was "on-the-air best," so I laid out for the HW-101. I already had the phone patch and electronic keyer by Heath. In the dream days of the SB series, I had even bought the assembly manual for the SB-102, so I had quite a familiar start with the new project.

Anxious to have the phone patch, I was surprised to find no mention of it in my first "charge" through the assembly manual for the 101! I checked the index and every part of the manual, carefully studied it even – no mention at all. Hmmm!

Then I went back to the SB-102 manual, and careful study revealed that it would be quite a simple matter to add the patch to the HW-101. And, the place already existed for the parts needed when I checked the Modulator Circuit Board in my kit. The holes are drilled and the board appears to be the same one used in the SB-102 unit.

All that's needed is a ½ Watt, 22 kΩ resistor, 2 feet of RG 174/U coax and the spare jack on the back of the HW-101 chassis. If you are putting a new kit together as I was, provide for it at this time. If not, just remove the covers and get down to where the action is.

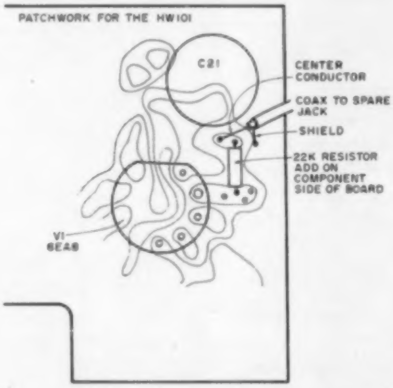

Fig. 1. Modulator circuit board (foil side).

Fig. 1 shows the corner of the modulator circuit board right around V1, foil side up. This is also available to you kit builders on page 188 of your manual, and is the upper right-hand corner of the illustration. The 22 kΩ resistor goes in the position indicated. Then the coax is put in as shown: the center conductor to the same island as the resistor and the braid to the outside or ground portion of the board. Holes are already there for the components.

Next, dress the coax back to the spare jack on the rear of the chassis. There you solder the center conductor of the coax to the center lug on the jack, and solder the shield to the ground lug. Be sure that you make a neat job of the coax as it runs back through the chassis; tie it off or thread it so that it will stay in place. Incidentally, there was enough spare coax in my kit to make up the piece for this purpose. If not, a 2-foot piece of RG 174/U will do the job.

Now all you need do is plug in your phone patch and you're ready to go. Since most of the components are the same as for the SB-102, you have actually made your kit more valuable, if you have done it neatly.

Happy patchwork! ■

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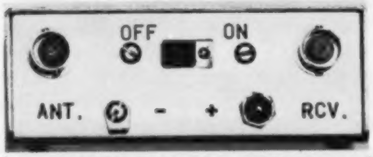

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R2

The History of Ham Radio

-- part IV

Eric Shalkhauser W9CI
527 Spring Creek Road
Washington IL 61571

During 1921, for sending their signals, amateurs were still thinking in terms of spark transmitters. The vacuum tube, as a simple three-element detector, was being advertised prominently and illustrated profusely in all the wireless literature. Not until the VT-1, 201, 202 and other tubes came along could much conversion from spark transmitters take place. It was well into the 1921-1922 period that this happened with the realization that wavelengths below 200 meters were of considerably more advantage for DX and better tuning characteristics than at 200 meters and above.

While in the Signal Corps Officer's Training Camp in College Park MD in 1918, I saw and operated the first three-tube transmitter. It was similar in appearance to the first three-tube DeForest set which was extensively advertised in radio periodicals in 1921. It came equipped with Western Electric VT-1 tubes.

Construction articles appeared monthly in the 1920 and 1921 magazines. These were simple circuit diagrams showing application. The Fessenden, Marconi, the Telefuncen, the Colpitts and many others were displayed. The radio amateur was doing a lot of experimenting in adapting this new device to all sorts of circuit layouts toward improving reception and transmission of signals.

Amateurs and commercial interests devised all sorts of receiving circuit combinations under such names as the *neutrodyne*, the *amplidyne*, the *Roberts*, the *Cockaday*, etc.

Peoria Radio Sales Co., 1923-1924.

One must remember that radio broadcasting had its real beginning in earnest right after World War I, and the general public became all agog over this new mysterious phenomenon entering their homes. Hearing strange voices and music out of nowhere . . . through earphones . . . without wires . . . It was unbelievable!

From now on the ham was no longer alone with his dots and dashes in his little cubicle, carrying on his own brand of mysterious private conversation.

Serious consideration was being given by the amateurs to the possibility of making improvements in signal reception by adding several stages of tube amplification to the detector. The single crystal detector and the old coherer could now be permanently replaced and abandoned. Those weak and often inaudible signals could now be picked out with ease and at a greater distance. And so, with the discovery of the regenerative circuit by Major Armstrong, the vacuum tube *started to oscillate* and gave signals a thousand fold boost in strength.

The vacuum tubes were not quite ready for transmission purposes. Their lack of ruggedness, their size, their cost and their scarcity held back adaptation by the amateur fraternity of tubes for strong CW signal generators. After the war, and even into 1922, amateurs who had served Uncle Sam were still operating their spark transmitters.

Many of us were familiar with either the Army Signal Corps or the Navy gear. They all looked and operated alike. In the beginning of wireless adaptation to the armed services, very little innovation could be expected for field combat purposes. The quenched gap transmitter stood out as a most reliable unit. To the ham this was proven equipment. True, it operated in many instances from a 500 cycle source of power, but it was regarded as a dependable unit to cover fairly long distances and was used by commercial companies in the field. It was semiportable when loaded on a horse, a mule, or two-wheeled cart.

The returning amateur was trained in the use of such transmitting equipment and took a fancy to the unit. He was very familiar with its performance, knew how to operate it, and had practical knowledge of its capabilities and application. During his period of service he was always thinking in terms of adapting it to his own use if and when he got back home. The one and only drawback was the 500 cycle power input. Replacing the quenched gap in the circuit proved a minor drawback.

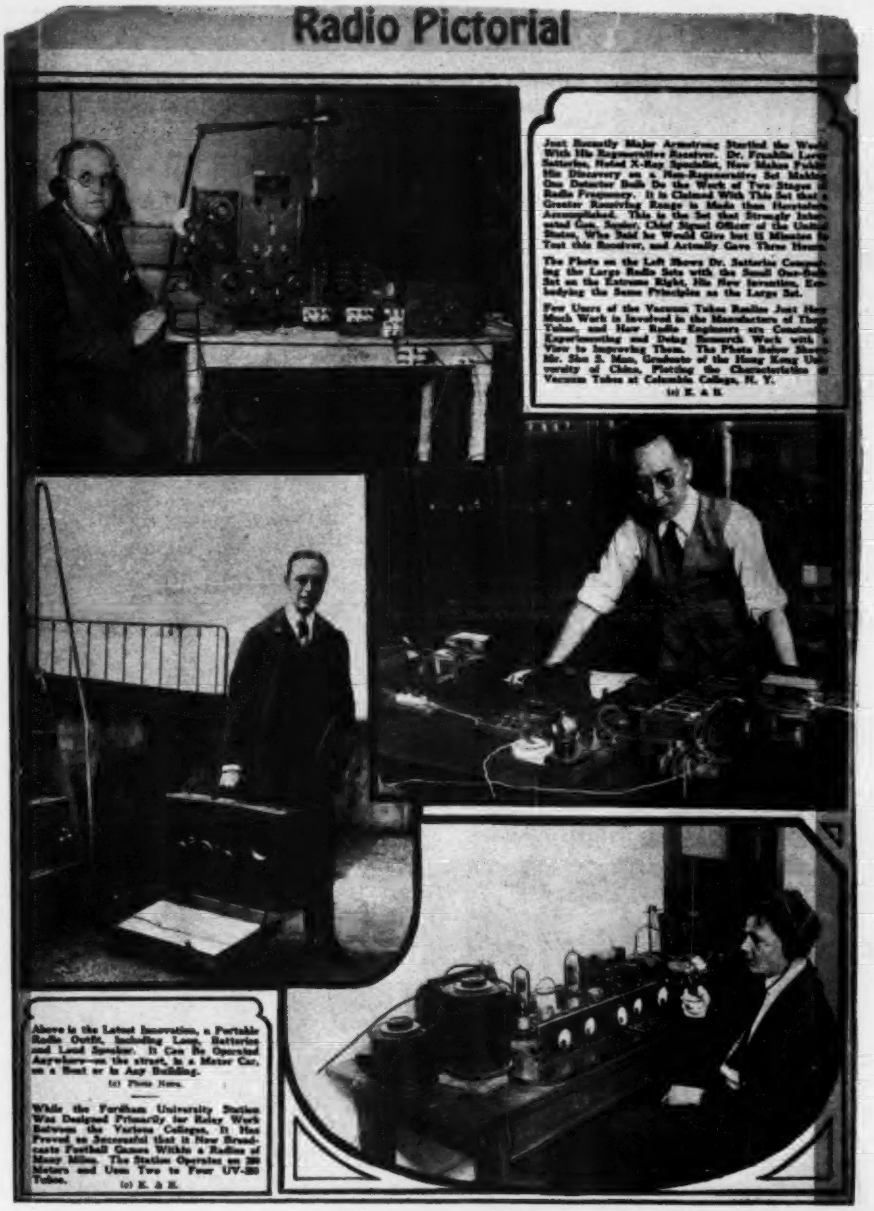
When we examine the spark gap circuit used in all stations as illustrated and described in the literature of the early 1920s, it can be said that it was really quite simple and direct, and not difficult to understand in operation and performance.

The "spark-gap-ham" preferred to build his own condenser. He would use glass plates, mostly 8" x 10" in size, obtained from a photographer who was ready to discard them. (Exposures were made on glass plates "in them olden days.") These were covered, both sides, with tin or aluminum foil or other thin metal sheets. Tobacco pouches were often sources of foil. Enough plates were coated so that the assembled condenser gave a value of .01-.012 uF. To make sure that the unit could withstand potential surges as high as 25,000 volts, four of these sections were connected in series-parallel, making the capacitance still the correct value, approximately 0.01 uF. The whole thing was immersed in oil. Not to do so caused corona discharges around the edges. Being well soaked made them stand up much better under the high potentials. Even then they punctured unexpectedly!

The high potential was quite dangerous around the place. It was important that the condenser box be surrounded by a protective wall and openly marked: DANGER – HIGH VOLTAGE – KEEP YOUR DISTANCE!

The discharge gap in the circuit is in series with the primary spiral inductance, usually made of flat-wound brass or copper ribbon. This was known as the oscillation transformer. Every time the key in the low voltage primary circuit was closed, the charged condenser let loose for the shortest fraction of a second, in rapid fire, and discharged across the spark gap. On discharge, the energy surged around the helical coil, and, in turn, the secondary coil inductively coupled to the primary received a burst of electromagnetic energy. This in turn sent a damped wave signal out into the ether by way of the antenna configuration. A hot wire ammeter in series with the antenna to ground connection indicated the amount of current being emmitted. A fuse block in the main power line provided protection against overloads.

Although the circuit



Radio Pictorial

Just Recently Major Armstrong Startled the World With His Regenerative Receiver. Dr. Franklin Leroy Satterlee, Noted X-Ray Specialist, Now Makes Public His Discovery on a Non-Regenerative Set Making One Detector Bulb Do the Work of Two Stages of Radio Frequency. It is Claimed With This Set that a Greater Receiving Range is Made than Heretofore Accomplished. This is the Set that Strongly Interested Gen. Squier, Chief Signal Officer of the United States, Who Said he Would Give but 15 Minutes to Test this Receiver, and Actually Gave Three Hours.

The Photo on the Left Shows Dr. Satterlee Comparing the Large Radio Sets with the Small One-Tube Set on the Extreme Right, His New Invention, Embodying the Same Principles as the Large Set.

Few Users of the Vacuum Tubes Realize Just How Much Work is Involved in the Manufacture of These Tubes, and How Radio Engineers are Constantly Experimenting and Doing Research Work with a View to Improving Them. The Photo Below Shows Mr. Shu S. Man, Graduate of the Hong Kong University of China, Plotting the Characteristics of Vacuum Tubes at Columbia College, N. Y.

(c) K. & H.

Above is the Latest Innovation, a Portable Radio Outfit, Including Loop, Batteries and Loud Speaker. It Can Be Operated Anywhere—on the street, in a Motor Car, on a Boat or in Any Building.

(c) Photo News.

While the Fordham University Station Was Designed Primarily for Relay Work Between the Various Colleges, It Has Proved so Successful that it Now Broadcasts Football Games Within a Radius of Many Miles. The Station Operates on 200 Meters and Uses Two to Four UV-203 Tubes.

(c) K. & H.

looked quite simple, we amateurs had other problems to contend with in meeting the 200 meter (or less) wavelength requirements. The condenser design value had to stay within the above stated uF limits. I will not attempt to delve into the mathematical equations to prove the point. Remember that we had a wrong concept of wavelength versus distance in those days.

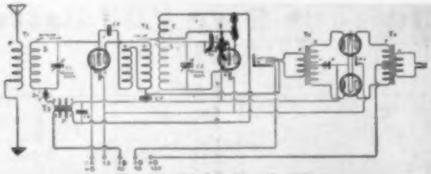
Some amateurs were in a position to obtain 500 cycle power generators. Many signals could be heard on the air using such units. The signal coming from a 500 cycle source had a distinct tone quality. It was music to many an ear.

By way of interest, here is a statement which appeared in *Radio Amateur News* in 1920:

> "Surely the US government is not imposing upon the American amateur when he limits the operating wavelength of your transmitter to 200 meters. Contrast this law to that of Canada where the limit is placed at *50 meters*. As a Canadian amateur recently remarked, with this short wave we may consider ourselves fortunate indeed to cover the extraordinary distance of one mile. As for democratic England, the would-be amateur is simply out of luck, for no license or permission is at present even obtainable under any condition. From the foregoing, we may therefore deduce the timely moral: *Keep your transmitter on the lawful side of 200 meters*."

The amateurs up to now had really not discovered the potentially great advantage of the shorter wavelengths.

The rotary gap caused havoc on many occasions, since the studs had a tendency to become pitted after a short time of operation unless constructed of stuff that withstood the constant arcing in an open oxygen atmosphere. Of considerable help was an enclosed gap, sufficiently airtight to exclude oxygen to the extent possible.



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Complete Parts 2-Tube Set

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2	Mica Condensers, .002 Mfd.	.80
1	Mica Condenser, .0025 Mfd.	.40
1	Amertran Audio Transformer	7.00
1	10 Ohm Rheostat with Knob	.75
1	UV 201A Socket	1.00
1	UV 199 Socket	.50
2	25 Ohm Resistance Strips	.50
1	Grid Condenser .00025 Mfd.	.45
1	Grid Leak 2 Meg.	.50
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7	Contact Prints	.07
7	Binding Posts	.35
1	Hard Rubber Panel 7 x 21 x 3/16 (Undrilled)	2.30
1	Wood Base	.75
	Misc. Spaghetti, Bus Bar, Screws, Nuts, Bolts	.75
		$34.32

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Complete Parts 4-Tube Set

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1	Base Board	.75
1	Set Nazeley Coils	8.00
2	Haynes-Griffin Extra Plate Vernier Condensers .0005 Mfd.	10.00
1	Switch Arm	.20
7	Switch Points	.07
2	Switch Stops	.02
4	Sockets $1.00 ea.	4.00
1	Amertran Transformer	7.00
2	Push Pull Transformers (set) Como	12.50
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2	Jacks (Open and Double Cir.)	1.40
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1	Grid Condenser .00025 Mfd.	.45
2	Micadons .005 and .0025	1.00
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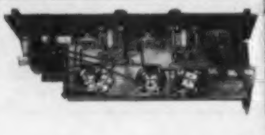
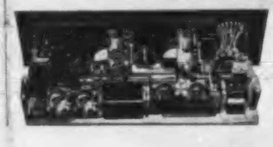
		$56.19





Much experimenting with the number of studs on the rotor and the speed of the motor improved the efficiency of the system. An 1800 rpm synchronous motor and a wheel with twelve well-designed studs, made of material that could withstand pitting, usually provided the right kind of pitch and whine to satisfy the critical ham in his quest to excel on the air.

By the characteristic frequency over the air, most ham stations were recognized without the usual QTH report. "I know the sound of his spark" was a common remark among hams.

After a station had its mechanical problems fairly well under control, the problem of decrement of the signal emitted received considerable attention. Specifications from the bureau in Washington decreed that the decrement could not, or should not, be higher than 0.2 when the energy was transferred to the antenna. Otherwise the signal emitted would be unduly broad with accompanying increased interference due to high damping.

What was this decrement all about? The subject was discussed at great lengths. It took front and center attention and was good for an argument anywhere, anytime. Decrement and how to meet its requirements waxed hot and furious from many podiums at conventions. Today you never hear the subject mentioned any more.

Decrement, logarithmic decrement: Nobody knew very much about the subject, even though the Department of Commerce issued their well known Bureau of Standards book entitled *Radio Instruments and Measurements #74*, on March 23, 1918. This gave technicians and engineers an in-depth documentation on the subject. Mr. B. West ex-8KEZ discussed spark dischargers at the St. Louis convention in 1920. In the course of his presentation, he was interrupted repeatedly by well-meaning listeners in the audience, as they confused the issue by introducing the "damping factor" and then wondering what was meant by *napierian*. The confusion usually brought down the house, and the heated discussion ended in a draw. Not even well-meaning intellectual cowhands from the western ranches knew what to make of these arguments and decided to leave well enough alone when they got back to their radio shacks.

So decrement, damping factor, impulse excitation, and increment — all these factors — were eventually solved the usual "over-the-ether-waves-reporting" way — experimentally — trial and error methods prevailing. It was understood that a low resistance (the lower the better) in the secondary discharge circuit gave a low decrement and allowed the energy to oscillate freely with consequent low heat loss. We seldom worried about impulse excitation any more.

Our problems were put away for a while until the next convention came along. This was to be the First National American Radio Relay League super meeting at the Edgewater Beach Hotel in Chicago, to be reviewed in the next chapter.

We go back to our midnight operating hours when all is quiet and serene about the house. The ham does not want disturbances to interfere with his concentration on distant code from some far-off place. Besides, when the key is closed, the spark noise could disturb the neighbors, and any intruders into the privacy of the shack would be overcome by the ozone that often permeated the atmosphere. QRX till we meet later on when fully recovered in fresh air environment. ■

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11C05DM	1 GHz Counter Divide by 4	110.50
11C06DC	UHF Prescaler 750 MHz D Type flip/flop	12.30
11C24DC	Dual TTL VCM same as MC4024P	2.60
11C44DC	Phase Freq. Detector same as MC4044P	2.60
11C58DC	ECL VCM	4.53
11C70DC	600 MHz flip/flop with reset	12.30
11C83DC	1 GHz 248/256 Prescaler	29.20
11C90DC	650 MHz Prescaler Divide by 10/11	16.00
11C90DM	same as above except Mil. version	24.00
11C91DC	605 MHz Prescaler Divide by 5/6	16.00
11C91DM	same as above except Mil. version	24.00
95H90DC	350 MHz Prescaler Divide by 10/11	9.50
95H90DM	same as above except Mil. version	16.50
95H91DC	350 MHz Prescaler Divide by 5/6	9.50
95H91DM	same as above except Mil. version	16.50
T.I. TMS4060/C2107, 4K RAM		19.01

Batteries

Gel-Cell 12 volts at 1.5 Amp Hr. #GC-1215 $19.95

Crystals

1.000000 MHz	4.95
5.000000 MHz	4.95
10.000000 MHz	4.95
3579.545 KC	2.95

JUST ARRIVED! These radios have just been pulled out of service. Set up for approx. 150 MHz. Clean. All tubes included. No accessories. Prices FOB Phoenix.

Motorola U43 GGT	$49.95
GE TPL	$99.95
GE MT-33	$39.95
6EMT42N	$79.95

10.7 MHz Narrow band Crystal Filters type 2194F $7.95

10.7 MHz Ceramic Filter
MuRata SFW10.7MA $3.95

Johanson and Johnson
Trimmer Capacitors

1 to 14 pf.	$1.95
1 to 20 pf.	$1.95

Ferrite Beads
12 for .99 or
120 for 9.99

FET's

2N3070	1.50	2N5460	.90	MFE3002	3.35
2N3436	2.25	2N5465	1.35	MPF102	.45
2N3458	1.30	2N5565	5.45	MPF121	1.50
2N3821	1.60	3N126	3.00	MPF4391	.80
2N3822	1.50	MFE2000	.90	U1282	2.50
2N4351	2.85	MFE2001	1.00	MMF5	5.00
2N4416	1.05	MFE2008	4.20	40673	1.39
2N4875	1.75	MFE2009	4.80	40674	1.49

TUBES

2E26	5.00	811	6.95	7984	4.95
3B28	4.00	811A	9.95	8072	32.00
4X150A	15.00	931A	11.95	8156	3.95
4X150G	18.00	5849	32.00	8908	9.95
4CX250B	24.00	6146A	5.25	8950	5.50
4CX350A/8321	35.00	6146B/8298A	6.25	4-400A	29.95
4CX15000	$150.00	6360	7.95	4-250A	24.95
DX415	25.00	6907	35.00	4-125A	20.95
572B/T160L	25.00	7377	40.00	4-65A	15.95

New Motorola Carbon Microphone Model P-7255A. This unit is a "noise cancelling" palm type microphone. These mikes come with or without cables. Price without cables $19.95; with cables $29.95.

H.P. 612A UHF Signal Generator 450 MHz to 1230 MHz $900.00
H.P. 624B Microwave test set 6565 MHz to 7175 MHz $9.00.00
Beckman Meter and Heterodyne Plug-in/Freq meter D.C. to 1 GHz $900.00

Motorola MC14410CP CMOS tone generator uses 1 MHz crystal to produce standard dual frequency telephone dialing signal. Directly compatible with our 12 key Chomeric pads. Kit includes the following.

1 MC14410CP

1 1 MHz Crystal
1 Printed Circuit Board (From Ham Radio Sept. 1975)
And all other parts for assembly. $15.70

Fairchild 95H90DC Prescaler divide by 10 to 350 MHz. Will take any 35 MHz Counter to 350 MHz. Kit includes the following.
1 95H90DC

1 2N5179
2 UG-88/u BNC's
1 Printed Circuit Board
And all other parts for assembly. $29.95

Fairchild 11C90DC Prescaler divide by 10 to 650 MHz. Will take any 65 MHz Counter to 650 MHz or with a 82S90 it will divide by 10/100 to 650 MHz. This will take a 6.5 MHz counter to 650 MHz. Kit includes the following.

1 11C90DC
1 2N5179
2 UG-88/U
1 MC7805CP
1 Bridge
1 Printed Circuit Board and all other parts for assembly.
82S90 add $5.70 to total. $59.95

TRANSFORMERS

F-18X	6.3vct at 6 amps	3.56
F-93X	6.5v to 40v at 750 ma.	3.53
F-92A	6.5v to 40v at 1 amp	4.59
N-51X	Isolation 115vac at 35va.	2.80
Model D-2	6.5v at 3.3 amps 6.5v at 3.3 amps	4.95
BE-12433-001	30v at 15 ma.	.49
BGH-9	6.3vct at 10 amps 115 vac at 100va Isolation	6.95
F-107Z	12V @ 4A or 24 V @ 2A	7.80

P6377 12v at 4 amps or 24v at 2 amps. $6.30

P6378 12v at 8 amps or 12v at 4 amps. $10.31

P8196 80vct at 1.2 amps $6.28

DIODES

1N270 Germanium Diodes	$7.95/c
HEP170, 2.5A, 1000 PIV	$4.95/20
Semtech SFMS 20K, 20KV, 10 ma, fast recovery	$1.26 ea.

FANS

Pamotor Fans, Model 4500C 117 VAC, 60 Hz, 19 w. $7.95

RF TRANSISTORS

2N1561	15.00			2N5590	6.30
2N1562	15.00	2N3866 JAN TX	4.85	2N5591	10.35
2N1692	15.00	2N3925	6.00	2N5635	4.95
2N1693	15.00	2N3927	11.50	2N5636	11.95
2N2631	4.20	2N3948	2.00	2N5637	20.70
2N2857	1.80	2N3950	26.25	2N5643	20.70
2N2876	12.35	2N3961	6.60	2N5641	4.90
2N2880	25.00	2N4072	1.70	2N5643	20.70
2N2927	7.00	2N4073	2.00	2N5764	27.00
2N2947	17.25	2N4135	2.00	2N5841	11.00
2N2948	15.50	2N4427	1.24	2N5842/MM1607	19.50
2N2949	3.90	2N4430	20.00	2N5849/MM1622	19.50
2N2950	5.00	2N4440	8.60	2N5852	50.00
2N3287	4.30	2N4957	6.30	2N5942	49.50
2N3300	1.05	2N5070	13.80	2N5922	10.00
2N3302	1.05	2N5090	6.90	2N6080	5.45
2N3307	10.50	2N5108	3.90	2N6081	8.60
2N3309	3.90	2N5109	1.55	2N6082	11.25
2N3375/MM3375	7.00	2N5179	.68	2N6083	12.95
2N3553	1.80	2N5184		2N6084	14.95
2N3571	4.10	2N5216	47.50	2N6094	5.75
2N3818	6.00	2N5583	5.60	2N6095	10.35
2N3824	3.20	2N5589	4.60	2N6096	19.35
2N3866	1.09			2N6097	28.00
2N3866 JAN	4.14				

RF TRANSISTORS

MRF207	2.00	Amperex BLY90	22.50	MM3002	1.65
MRF208	10.20	Amperex A209	8.60	MM3009	1.80
MRF209	12.35	MSC 2001	20.00	MM3375	7.00
MRF237	1.85	MSC 3000	20.00	MM3904	1.50
MRF238	8.55	MSC 3001	20.00	MM3906	1.43
MRF450	16.55	MSC 3005	20.00	MM4000	1.24
MRF453	19.55	MSC 80205	20.00	MM4001	1.39
MRF504	6.75	MSC 80206	20.00	MM4003	1.85
MRF509	5.50	MSC 80255	20.00	MM4036	1.60
MRF511	8.60	Fairchild SE7056	3.00	MM4044	3.00
MRF620	27.00	MM1051	2.00	MM4545	3.00
MRF8004	1.90	MM1500	32.20	MM8006	2.15
HEPS3013/75	2.95	MM1550	10.00	MM1552	50.00
HEPS3014/76	4.95	MM1601	5.50	MM1553	56.50
HEPS3002	11.03	MM1602	7.50	HEPS5026	2.48
HEPS3003	29.88	MM1607/2N5842	8.65	MSC 80256	20.00
HEPS3005	9.55	MM1614	2.75	CTC D1-28	20.00
HEPS3006	19.90	MM1620	17.50	CTC D10-28	20.00
HEPS3007	24.95	MM1622/2N5849	19.50	CTC E1-28	20.00
HEPS3008	2.18	MM1661	15.00		
HEPS3010	11.34	MM1669	17.50		
RCA TA7994	50.00	MM1943	3.00		
RCA 40290	2.48	MM2605	3.00		
Kertron K2126	5.50	MM2608	5.00		
Kertron KB6008	5.50				

MHz electronics

2543 N. 32nd STREET
PHOENIX, ARIZONA 85008
PH. 602-957-0786

NO C.O.D.

M8

Al Gerbens K7SBK
1038 E. 6th Place
Mesa AZ 85203

Dipole Designer Program

- - calculates coils and length

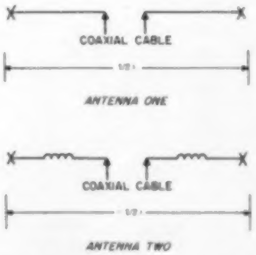

Fig. 1. Dipole Antenna Considerations.

The resonant half wavelength dipole can be shortened considerably using a pair of loading coils to provide lumped inductance between the center feed point and the ends of the antenna (Fig. 1). Both of these configurations can be resonant at the same frequency.

What's the tradeoff? The reduced physical length costs you bandwidth at any swr level of your choice. If you're using less than a couple hundred feet of RG-8 or RG-11 and your lot is as small as mine, then that's an attractive exchange.

The Dipole Designer program is written to help you juggle the variables involved. It can be broken down into 3 areas.

Program Description

The first area is the calcu-

Program listing for Loaded Dipole Design program. Written in Digital Group Maxi-BASIC Version 1. (Program plus BASIC requires approximately 17K.)

```
  2 FOR K = 1 TO 16: #" ":NEXT K
  4 #"LOADED DIPOLE DESIGN"
  6 #"<-----------------L--------
     ----->"
  8 #"X----- <>------- ------<>
     ----- X"
 10 FOR K = 1 TO 4
 12 #"                    ↑↑ ":NEXT K
 14 #"<>= LOADING COIL"
 16 #"X-TO-X DISTANCE = OVERALL ANTENNA"
 18 #"LENGTH."
 20 #"THE DIPOLE IS FED IN THE CENTER"
 22 #"& THE FEEDLINE TO LOADING COIL"
 24 #"DISTANCE IS A VARIABLE YOU WILL"
 26 #"INPUT ":FOR K = 1 TO 9000:NEXT K
 28 FOR K = 1 TO 16: #" ": NEXT K
 30 #"               DATA INPUT"
 32 #"               -----------"
 34 INPUT "PLEASE ENTER THE TARGET
    RESONANT FREQ. IN MHZ",F
 36 IF F<=0 THEN 34
 38 IF F>31 THEN #"THIS PROGRAM IS ONLY
    VALID TO APPROXIMATELY 30 MHZ"
 40 IF F>31 THEN 34
 42 FOR K = 1 TO 16: #" ":NEXT K
 44 #"ONE HALF WAVELENGTH DIPOLE AT"
 46 #F;" MHz"
 48 #"HAS AN OVERALL LENGTH OF"
 50 #468/F;" FEET": FOR K = 1 TO 2000:NEXT:
   FOR K = 1 TO 16: #" ":NEXT K
 52 INPUT "WHAT IS THE DISTANCE IN FEET
          FROM THE CENTER OF THE DIPOLE
   TO EACH LOADING COIL?", B
 54 IF B<=0 THEN 52: IF B>230/F THEN 52
 56 INPUT "WHAT GAGE WIRE ARE YOU USING?",
    G1
 58 IF G1<2 THEN 56
 60 IF INT (G1/2)=(G1)/2 THEN G=G1 ELSE G=G1+1
 62 IF G>32 THEN 56
 64 GOSUB 138
 66 INPUT "WHAT IS THE OVERALL ANT.
    LENGTH IN FEET?",L
 68 IF L<=0 THEN 66
 70 IF L>465/F THEN #"TOO LONG, YOU WILL NEED
    CAPACITIVE LOADING"
 72 IF L>465/F THEN 66
 74 IF L<2*B THEN #"COILS ARE OUTSIDE
    OF ANTENNA TRY AGAIN!!"
 76 IF L<2*B THEN 66
 78 GOSUB 112
 80 #"THE REQUIRED LOAD INDUCTANCE"
 82 #"IS ="; C0;"MICROHENRYS."
 84 INPUT "JUMP TO COIL DESIGN?
    (Y OR N)",A$
 86 IF A$ = "Y" THEN GOSUB 176
 88 FOR K = 1 TO 1000:NEXT K
 90 #"WANT?"
 92 #"1 – COIL DESIGN"
 94 #2 – STOP": #:3 – EXAMINE EFFECT ON
    VARIABLE CHANGES":"4 – RESTART"
 96 INPUT K
 98 IF K = 1 THEN A$ = "Y"
100 IF K = 1 THEN 86
102 IF K = 2 THEN 110
104 IF K = 3 THEN GOSUB 226
```

```
106 IF K = 3 THEN 90
108 IF K = 4 THEN 30
110 END
112 C1 = 1.E6/(69*9.8696*F*F)
114 C2 = LOG((24/D)*(234/F-B))-1
116 S = (1-(F*B)/234)
118 S2 = S*S
120 C3 = S2-1
122 C4 = (234/F)-B
124 C5 = LOG((24*(L/2-B))/D)-1
126 T = (F*L/2-F*B)/234
128 T2 = T*T
130 C6 = T2-1
132 C7 = (L/2)-B
134 C0 = C1*((C2*C3/C4)-(C5*C6/C7))
136 RETURN
138 IF G = 2 THEN D = .258
140 IF G = 4 THEN D = .204
142 IF G = 6 THEN D = .162
144 IF G = 8 THEN D = .129
146 IF G = 10 THEN D = .102
148 IF G = 12 THEN D = .081
150 IF G = 14 THEN D = .064
152 IF G = 16 THEN D = .051
154 IF G = 18 THEN D = .040
156 IF G = 20 THEN D = .032
158 IF G = 22 THEN D = .025
160 IF G = 24 THEN D = .020
162 IF G = 26 THEN D = .016
164 IF G = 28 THEN D = .013
166 IF G = 30 THEN D = .010
168 IF G = 32 THEN D = .008
170 RETURN
172 GOSUB 176
174 GOTO 226
176 #"THE VALUE OF INDUCTANCE CURR-"
178 #"ENTLY IN MEMORY IS:"
180 #C0: #"DO YOU WANT TO USE THIS"
182 #"VALUE IN DESIGNING A COIL?"
184 INPUT "ENTRY Y OR N", A$
186 IF A$ = "Y" THEN 190
188 INPUT "PLEASE ENTER THE NEW VALUE IN
    MICROHENRYS", C0
190 IF C0 = 0 THEN 176
192 INPUT "WHAT IS THE DIAMETER OF THE COIL
    IN INCHES?",R
194 IF R = 0 THEN 192
196 R = ABS (R/2)
198 INPUT "ENTER THE NUMBER OF TURNS PER INCH
    OF COIL LENGTH",T
200 T = ABS(T)
202 IF T = 0 THEN 198
204 #"------------------------------"
206 #"COIL DIAMETER = ";2*R;"INCHES"
208 #"COIL WOUND AT";T;"TURNS/INCH"
210 L(1) = ((10*C0)+SQRT((100*C0*C0)-(4*R*R*T*T
    *(-9)*R*C0)))/(2*R*R*T*T)
212 L(2) = ((10*C0)–SQRT((100*C0*C0)-(4*R*R*T*T
    *(-9)*R*C0)))/(2*R*R*T*T)
214 IF L(1) > L(2) THEN L(3) = L(1)
216 IF L(2) > L(1) THEN L(3) = L(2)
218 #"COIL LENGTH = "; L(3); "INCHES"
220 #"TOTAL TURNS = "; T*L(3)
221 #"INDUCTANCE = "; C0;"MICROHENRYS: #"---
    ---------------------------"
222 FOR K = 1 TO 5000:NEXT K
224 RETURN
226 #"TO EXAMINE THE EFFECT ON COIL"
228 #"INDUCTANCE OF CHANGING A"
230 #"VARIABLE, ENTER AN APPROPRIATE"
232 #"NUMBER"
234 #"1-FEEDPOINT TO COIL DISTANCE"
236 #"2-OVERALL LENGTH"
238 #"3-WIRE SIZE"
240 #"4-RETURN FOR NEW DESIGN"
242 #"5-RETURN TO COIL DESIGN"
244 INPUT " #",V
246 IF V = 1 THEN 258
248 IF V = 2 THEN 298
250 IF V = 3 THEN 336
252 IF V = 4 THEN 30
254 IF V = 5 THEN 172
256 GOTO 226
258 #"LOAD CHANGE WITH FEEDPOINT"
260 #"TO LOADING COIL DISTANCE"
262 #"CHANGE"
264 FOR K = 1 TO 1000:NEXT K
266 #"OVERALL LENGTH = ";L;"FT"
268 #"RESONANT FREQ. = ";F;"MHZ"
270 #"WIRE SIZE = ";G;"GAGE"
272 #" ------------------------------"
274 FOR K = 1 TO 1000:NEXT K
276 #"CENTER TO COIL     INDUCTANCE"
278 #"DIST.(FT)              MICROHENRYS"
280 Q = B
282 FOR B = (.05*L) TO (.45*L) STEP (.05*L)
284 #B;
286 GOSUB 112
288 #TAB(16);C0
290 NEXT B
292 B = Q
294 INPUT "READY TO CONTINUE?",A$
296 GOTO 226
298 #"LOAD CHANGE WITH CHANGE IN"
300 #"OVERALL ANTENNA LENGTH:"
302 FOR K = 1 TO 1000:NEXT K
304 #"CENTER TO COIL DISTANCE = ";B;"FT."
306 #"RESONANT FREQ.= ";F;"MHZ"
308 #"WIRE SIZE = ";G;"GAGE"
310 FOR K = 1 TO 2000:NEXT K
312 Q = L
314 #"------------------------------"
316 #"TOTAL LENGTH       INDUCTIVE LOAD"
318 #"FEET                    MICROHENRYS"
320 FOR L = (2.4*B) TO (465/F) STEP (((230/F)
    -(2.4*B))/4)
322 #L;
324 GOSUB 112
326 #TAB(16);C0
328 NEXT L
330 L = Q
332 FOR K = 1 TO 3000:NEXT K
334 GOTO 294
336 #"CHANGE IN LOAD WITH CHANGE"
338 #"IN ANTENNA WIRE SIZE"
340 FOR K – 1 TO 1000:NEXT K
342 #"RESONANT FREQUENCY = ";F;"MHZ"
344 #"LENGTH = ";L;"FT"
346 #"CENTER TO COIL DIST. = ";B;"FT"
348 FOR K = 1 TO 2000:NEXT K
350 #" ------------------------------"
352 #"WIRE SIZE            INDUCTANCE LOAD"
354 #"(GAGE)               MICROHENRYS"
356 P = G
358 FOR G = 6 TO 28 STEP 2
360 #" ";G;
362 GOSUB 138
364 GOSUB 112
366 #TAB(16);C0
368 NEXT G
370 G = P
372 GOTO 294
```

lation of the size of the inductive loading coil you will need to insert in each leg of the antenna. The computer asks you to input:

a) the desired resonant frequency in MHz;

b) the distance in feet from the center of the antenna to where you want to place the loading coils;

c) the size of wire you are going to use in constructing the antenna. This information is entered as wire gauge size. Buried in the program is a wire gauge to wire diameter conversion lookup table;

d) the overall length from end to end that your new antenna will have to be in order to fit in the space you have available.

The computer will then promptly display the inductance in microhenrys required to meet the above design variables.

```
RUN
LOADED DIPOLE DESIGN
<-----------------L------------->
X-----<>-------   ------<>-----X
               ↑↑
               ↑↑
<>= LOADING COIL
X TO X DISTANCE = OVERALL ANTENNA
LENGTH.
THE DIPOLE IS FED IN THE CENTER
& THE FEEDLINE TO LOADING COIL
DISTANCE IS A VARIABLE YOU WILL
INPUT

                DATA INPUT
                ------------

PLEASE ENTER THE TARGET RESONANT
FREQ. IN MHZ –
7.123
ONE HALF WAVELENGTH DIPOLE AT
7.123 MHZ
HAS AS OVERALL LENGTH OF
65.702 FEET
WHAT IS THE DISTANCE IN FEET
FROM THE CENTER OF THE DIPOLE TO
EACH LOADING COIL?
5
WHAT GAGE WIRE ARE YOU USING?
18
WHAT IS THE OVERALL ANTENNA LENGTH
IN FEET?
37.5
THE REQUIRED LOAD INDUCTANCE
IS = 11.54 MICROHENRYS.
JUMP TO COIL DESIGN? (Y OR N)
Y
THE VALUE OF INDUCTANCE CURR-
ENTLY IN MEMORY IS:
11.54
DO YOU WANT TO USE THIS
VALUE IN DESIGNING A COIL?
ENTER Y OR N
Y
WHAT IS THE DIAMETER OF THE COIL
IN INCHES?
2
ENTER THE NUMBER OF TURNS PER
INCH OF COIL LENGTH
8
------------------------

COIL DIAMETER = 2 INCHES
COIL WOUND AT 8 TURNS/INCH
COIL LENGTH = 2.46 INCHES
TOTAL TURNS = 19.69
INDUCTANCE = 11.54 MICROHENRYS
------------------------

WANT?
1 – COIL DESIGN
2 – STOP
3 – EXAMINE EFFECT OF VARIABLE CHANGES
4 – RESTART
?
3
TO EXAMINE THE EFFECT ON COIL
INDUCTANCE OF CHANGING A
VARIABLE, ENTER AN APPROPRIATE
NUMBER:
1 – FEEDPOINT TO COIL DISTANCE
2 – OVERALL LENGTH
3 – WIRE SIZE
4 – RETURN FOR NEW DESIGN
5 – RETURN TO COIL DESIGN
1
LOAD CHANGE WITH FEEDPOINT
TO LOADING COIL DISTANCE CHANGE
OVERALL LENGTH = 37.5 FT.
RESONANT FREQ. = 7.123 MHZ
WIRE SIZE = 18 GAGE
------------------------

CENTER TO COIL          INDUCTANCE
DIST. (FT.)             MICROHENRYS
   1.875                   9.606
   3.750                  10.655
   5.625                  12.050
   7.500                  13.970
   9.375                  16.734
  11.250                  20.973
  13.125                  28.128
  15.000                  42.333
  16.875                  82.605
READY TO CONTINUE?
Y
TO EXAMINE THE EFFECT ON COIL
INDUCTANCE OF CHANGING A
VARIABLE, ENTER AN APPROPRIATE
NUMBER:
1 – FEEDPOINT TO COIL DISTANCE
2 – OVERALL LENGTH
3 – WIRE SIZE
4 – RETURN FOR NEW DESIGN
5 – RETURN TO COIL DESIGN
#2
LOAD CHANGE WITH CHANGE IN
OVERALL ANTENNA LENGTH.
CENTER TO COIL DISTANCE = 5 FT.
RESONANT FREQ. = 7.123 MHZ
WIRE SIZE – 18 GAGE
------------------------

TOTAL LENGTH            INDUCTANCE LOAD
FEET                    MICROHENRYS
   12.                     155.760
   17.072                   52.082
   22.145                   31.047
   27.217                   21.399
   32.300                   15.619
   37.362                   11.630
   42.435                    8.620
   47.507                    6.205
   52.580                    4.178
   57.652                    2.412
   62.724                    0.851
READY TO CONTINUE?
Y
TO EXAMINE THE EFFECT ON COIL
INDUCTANCE OF CHANGING A
VARIABLE, ENTER AN APPROPRIATE
NUMBER:
1 – FEEDPOINT TO COIL DISTANCE
2 – OVERALL LENGTH
3 – WIRE SIZE
4 – RETURN FOR NEW DESIGN
5 – RETURN TO COIL DESIGN
#3
CHANGE IN LOAD WITH A CHANGE
IN ANTENNA WIRE SIZE.
RESONANT FREQ. = 7.123 MHZ
LENGTH = 37.5 FT.
CENTER TO COIL DISTANCE = 5 FT.
------------------------

WIRE SIZE               INDUCTIVE LOAD
(GAGE)                  MICROHENRYS
   6                        9.489
   8                        9.822
  10                       10.166
  12                       10.504
  14                       10.849
  16                       11.182
  18                       11.538
  20                       11.865
  22                       12.226
  24                       12.553
  26                       12.880
  28                       13.185
READY TO CONTINUE?
```

Sample run of Loaded Dipole Design program.

At this point you're probably wondering where you stashed that coil design slide rule. Look no further, because that's section two of the program.

First you're given a choice of starting with the value of inductance just calculated or a new value. In either case it's in microhenrys. The program then asks you to input:

a) coil diameter in inches, and

b) the number of turns per inch you plan to wind the coil at.

Using this data the computer will return both the overall coil length and the total number of turns required to obtain the design inductance.

Curious about what effect the wire size really has? How about changes in overall length? Or what happens when you move those coils away from the center of the antenna toward the ends? The third section of the program takes care of these variables.

Using the Program

Just select the appropriate option after the list is displayed and a table will be generated showing the change in inductive load (in microhenrys) with one of the design parameters changed over a wide range.

The first option is an analysis of what happens when feedpoint to loading coil distance is changed. The inductance of the loading coil required to produce resonance is listed in one column of the table and the center to load distance in a second column. The number of feet the coil is from the feedline starts at 5% of the overall antenna length you previously inputted and goes to 45% of the overall length in 5% increments. Does the inductance of the coil increase or decrease as it moves away from the feedpoint?

Choose the second option, and your computer will generate a table of load inductance in one column and overall dipole length in the other column. The center to coil distance you originally specified is used. The overall antenna length starts at 2.4 times the center to coil distance and goes to almost one half wavelength. Sure enough, the inductance approaches zero as the overall length approaches half wavelength.

How about the wire size? Why is it even taken into consideration? Well, choose option three and look at a comparison of required inductive load to wire size with wire size going from 6 gauge to 28 gauge in steps of 2. Interesting.

A few comments about the program. It runs in about 4.6K of BASIC, not counting the memory consumed by the BASIC interpreter. I have it running on an 18K Z-80 Digital Group System. If memory capacity is a problem, the program can be chopped into 3 major areas described and portions deleted as required.

You could also delete the wire gauge to wire radius conversion section and enter wire radius in inches, to save a couple hundred words.

There are no remarks. However, I think the liberal use of print commands makes the program fairly easy to follow.

Formatted print commands were deliberately avoided to save confusion in applying this program with different systems. The language is Digital Group Software Systems Maxi-BASIC Version 1.

How about adding a section for inverted vee configurations? Extracting the loading for verticals and whips should be relatively easy, too. ■

References

1. ***Reference Data for Radio Engineers,*** **5th Edition, 4th Printing, 1972, Copyright H.W. Sams, 1968, pages G-1, G-3.**

2. ***QST*, September, 1974, page 209.**

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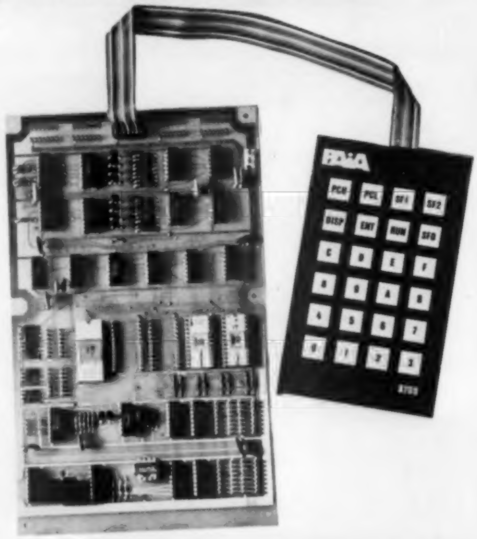

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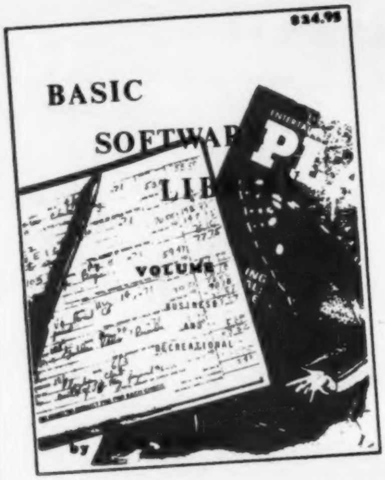

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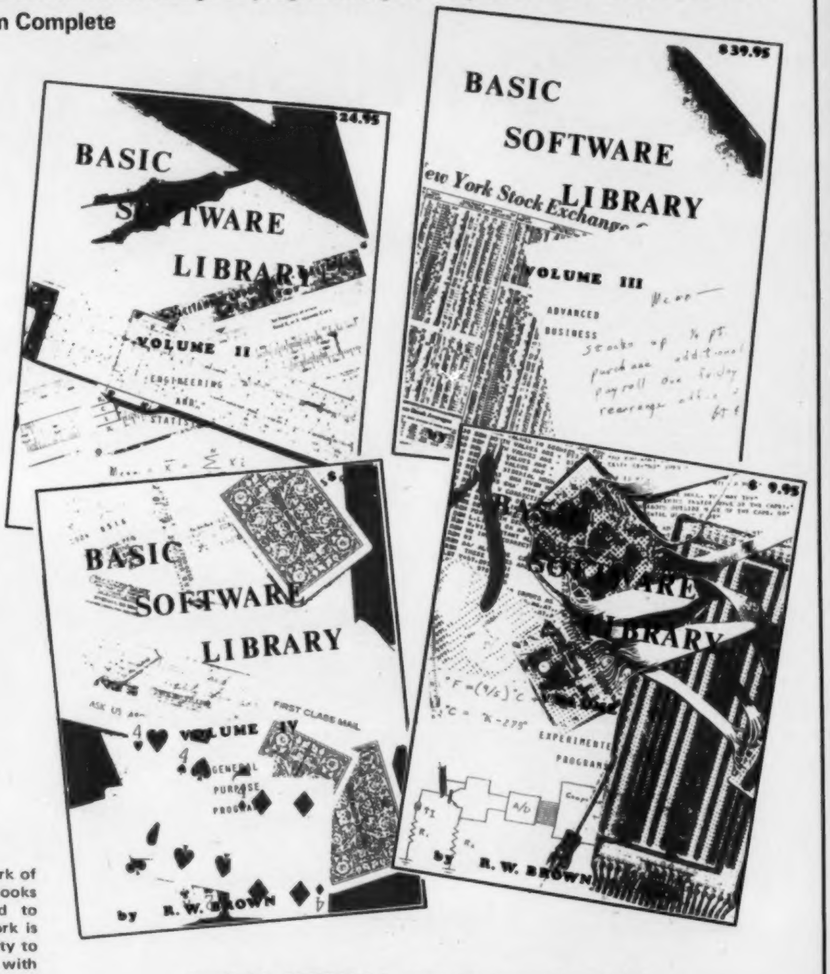

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Software Control

- - for High Quality Video Display

Don Alexander WA8VNP
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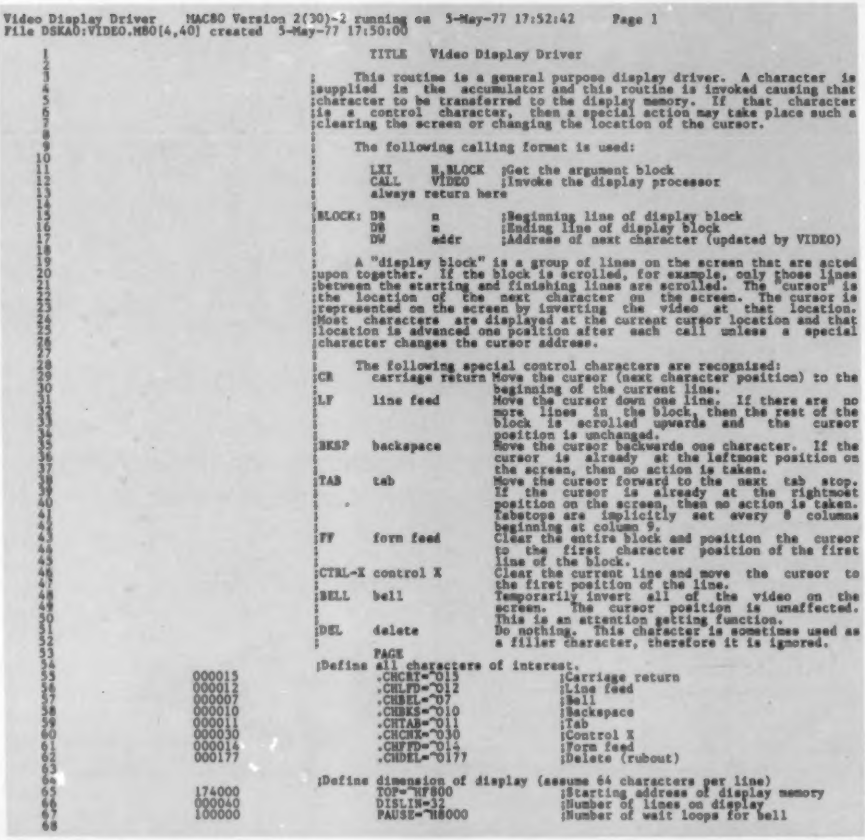
In the March, 1977, issue of *73* I described a video display which is seen to be a part of memory by the computer. This article is to present a software driver for that display.

The operation of the display is essentially that of a window to a portion of the computer's memory. The computer can read or write randomly to any portion of the display memory just as it can with its normal memory. In fact, programs may even be executed from the display memory. When the processor is not accessing the display memory, the display circuitry takes over and uses that memory to generate a video signal. As a result, display functions such as line feeding or erasing are software processes.

The program provides these basic functions:

1. Carriage return;



```
Video Display Driver    MAC80 Version 2(30)-2 running on  5-May-77 17:52:42     Page 1
File DSKA0:VIDEO.M80[4,40] created  5-May-77 17:50:00

                                         TITLE   Video Display Driver

                                    ;    This routine is a general purpose display driver.  A character  is
                                    ;supplied  in  the  accumulator and this routine is invoked causing that
                                    ;character to be transferred to the display memory.  If  that  character
                                    ;is  a  control  character,  then a special action may take place such a
                                    ;clearing the screen or changing the location of the cursor.
                                    ;
                                    ;    The following calling format is used:
                                    ;
                                    ;     LXI     H,BLOCK  ;Get the argument block
                                    ;     CALL    VIDEO    ;Invoke the display processor
                                    ;     always return here
                                    ;
                                    ;BLOCK: DB    n        ;Beginning line of display block
                                    ;       DB    m        ;Ending line of display block
                                    ;       DW    addr     ;Address of next character (updated by VIDEO)
                                    ;
                                    ;    A "display block" is a group of lines on the screen that are acted
                                    ;upon together.  If the block is scrolled, for example, only those lines
                                    ;between the starting and finishing lines are scrolled.  The "cursor" is
                                    ;the  location  of  the  next  character  on  the screen.  The cursor is
                                    ;represented on the screen by inverting  the  video  at  that  location.
                                    ;Most  characters  are displayed at the current cursor location and that
                                    ;location is advanced one position after  each  call  unless  a  special
                                    ;character changes the cursor address.
                                    ;
                                    ;    The following special control characters are recognized:
                                    ;CR      carriage return Move the cursor (next character position) to the
                                    ;                        beginning of the current line.
                                    ;LF      line feed       Move the cursor down one line.  If there are  no
                                    ;                        more  lines  in  the block, then the rest of the
                                    ;                        block  is  scrolled  upwards  and  the    cursor
                                    ;                        position is unchanged.
                                    ;BKSP    backspace       Move the cursor backwards one character.  If the
                                    ;                        cursor  is  already  at the leftmost position on
                                    ;                        the screen, then no action is taken.
                                    ;TAB     tab             Move the cursor forward to the  next  tab  stop.
                                    ;                        If  the  cursor  is  already  at  the  rightmost
                                    ;                        position on the screen, then no action is taken.
                                    ;                        Tabstops are  implicitly  set  every  8  columns
                                    ;                        beginning at column 9.
                                    ;FF      form feed       Clear the entire block and position  the  cursor
                                    ;                        to  the  first  character  position of the first
                                    ;                        line of the block.
                                    ;CTRL-X control X        Clear the current line and move  the  cursor  to
                                    ;                        the first position of the line.
                                    ;BELL    bell            Temporarily invert  all  of  the  video  on  the
                                    ;                        screen.  The  cursor  position  is  unaffected.
                                    ;                        This is an attention getting function.
                                    ;DEL     delete          Do nothing.  This character is sometimes used as
                                    ;                        a filler character, therefore it is ignored.
                                         PAGE
                                    ;Define all characters of interest.
             000015                      .CHCRT=^O15            ;Carriage return
             000012                      .CHLFD=^O12            ;Line feed
             000007                      .CHBEL=^O7             ;Bell
             000010                      .CHBKS=^O10            ;Backspace
             000011                      .CHTAB=^O11            ;Tab
             000030                      .CHCNX=^O30            ;Control X
             000014                      .CHFFD=^O14            ;Form feed
             000177                      .CHDEL=^O177           ;Delete (rubout)

                                    ;Define dimension of display (assume 64 characters per line)
             174000                      TOP=^HF800             ;Starting address of display memory
             000040                      DISLIN=32              ;Number of lines on display
             100000                      PAUSE=^H8000           ;Number of wait loops for bell
```

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```
000000  365             VIDEO:  PUSH    PSW             ;Save registers
000001  305                     PUSH    B
000002  325                     PUSH    D
000003  106                     MOV     B,M             ;Get parameters, starting line
000004  043                     INX     H
000005  116                     MOV     C,M             ;Stopping line
000006  043                     INX     H
000007  136                     MOV     E,M             ;Low cursor address
000010  043                     INX     H
000011  126                     MOV     D,M             ;High cursor addrwes
000012  345                     PUSH    H               ;Save H and L as well
000013  376 015                 CPI     .CHCRT          ;Is this a carriage return?
000015  312 110 000             JZ      XCRT            ;If so, do a carriage return
000020  376 012                 CPI     .CHLFD          ;Is this a line feed?
000022  312 211 000             JZ      XLFD            ;If so, do a line feed
000025  376 007                 CPI     .CHBEL          ;Is this a bell?
000027  312 333 000             JZ      XBEL            ;If so, invert the entire screen
000032  376 010                 CPI     .CHBKS          ;Is this a backspace?
000034  312 147 000             JZ      XBKS            ;If so, do a backspace
000037  376 030                 CPI     .CHCNX          ;Is this a control X?
000041  312 164 000             JZ      XCNX            ;If so, do a control X
000044  376 011                 CPI     .CHTAB          ;Is this a tab?
000046  312 122 000             JZ      XTAB            ;If so, do a tab
000051  376 014                 CPI     .CHFFD          ;Is this a form feed?
000053  312 305 000             JZ      XFFD            ;If so, do a form feed
000056  376 177                 CPI     .CHDEL          ;Is this a delete?
000060  312 076 000             JZ      CURSR1          ;If so, go do nothing
                                PAGE
                        ;Here for non-special characters.
000063  022                     STAX    D               ;Put the character in display memory
000064  023                     INX     D               ;Point to next character
000065  173                     MOV     A,E             ;Get the low address bits
000066  346 077                 ANI     ^H3F            ;Check for the start of a new line
000070  312 205 000             JZ      LF1             ;If so, do an automatic line feed
000073  315 024 001     CURSOR: CALL    INVCHR          ;Invert this character
000076  341             CURSR1: POP     H               ;Restore HL
000077  162                     MOV     M,D             ;Update caller's cursor address
000100  053                     DCX     H
000101  163                     MOV     M,E
000102  053                     DCX     H
000103  053                     DCX     H               ;Point HL back where it was
000104  321                     POP     D               ;Restore other registers
000105  301                     POP     B
000106  361                     POP     PSW
000107  311                     RET                     ;Return to caller

                        ;Here for a carriage return.
000110  315 024 001     XCRT:   CALL    INVCHR          ;Invert this character back to ordinary
000113  173                     MOV     A,E             ;Get the address
000114  346 300                 ANI     ^HC0            ;Make it point to beginning of line
000116  137                     MOV     E,A             ;Put it back in E
000117  303 073 000             JMP     CURSOR          ;Go do cursor

                        ;Here for a horizontal tab DECsystem-10 style.
000122  315 024 001     XTAB:   CALL    INVCHR          ;Turn off inversion
000125  173                     MOV     A,E             ;Get low address
000126  346 370                 ANI     -7              ;Zero bottom 3 bits
000130  137                     MOV     E,A             ;Put back into E
000131  041 010 000             LXI     H,8             ;Add 8 to cursor address
000134  031                     DAD     D
000135  353                     XCHG
```

Continued

2. Line feed;
3. Backspace;
4. Horizontal tab;
5. Form feed (erases the display);
6. Clear line;
7. Bell (an inaudible bell, no less);
8. Cursor;
9. Do nothing. (Most terminals accept a filler character which does nothing.)

Calling parameters to the program are used to define the beginning and end lines of the display block to be used and to specify the current cursor address. On return from the display routine all registers and status flags are restored, and the cursor address in the parameter list will have been updated.

Most normal applications of the display use all 32 lines and therefore would specify lines 0 and 31 in the parameter list. But, referring to page 82 of the March, 1977, *73*, you will see an example where I have several display blocks in use simultaneously.

```
000136  173                     MOV     A,E             ;Get low address
000137  346 077                 ANI     ^H3F            ;Check for new line
000141  312 205 000             JZ      LF1             ;If so, do a line feed
000144  303 073 000             JMP     CURSOR          ;Otherwise do a cursor

                        ;Here for backspace.
000147  315 024 001     XBKS:   CALL    INVCHR          ;Uninvert this character
000152  173                     MOV     A,E             ;Get low address
000153  346 077                 ANI     ^H3F            ;At beginning of line?
000155  312 073 000             JZ      CURSOR          ;If so, don't backspace
000160  033                     DCX     D               ;Otherwise back up one
000161  303 073 000             JMP     CURSOR          ;Move cursor
                                PAGE
                        ;Here for a control X.
000164  016 077         XCNX:   MVI     C,63            ;Get 63 in C
000166  173                     MOV     A,E             ;Get low address
000167  366 077                 ORI     ^H3F            ;Adjust to end of line
000171  137                     MOV     E,A             ;Restore address
000172  076 040                 MVI     A," "           ;Get a blank
000174  022             CXLOOP: STAX    D               ;Write blank to display
000175  015                     DCR     C               ;Decrease count
000176  372 073 000             JM      CURSOR          ;If minus, go move cursor
000201  033                     DCX     D               ;Move pointer back
000202  303 174 000             JMP     CXLOOP          ;And go blank it out

                        ;Here to do a line feed.
000205  033             LF1:    DCX     D               ;Entry for auto line feed
000206  303 214 000             JMP     XLFD1           ;Do not invert
000211  315 024 001     XLFD:   CALL    INVCHR          ;Uninvert present character
000214  041 000 010     XLFD1:  LXI     H,-TOP          ;Get negative of screen start
000217  031                     DAD     D               ;Add cursor address to get count
000220  175                     MOV     A,L             ;Get low count
000221  007                     RLC                     ;Get high two bits into low two bits
000222  007                     RLC
000223  346 003                 ANI     3               ;Zero the other bits
000225  157                     MOV     L,A             ;Save this number
000226  174                     MOV     A,H             ;Get high count
000227  007                     RLC                     ;Multiply by four
000230  007                     RLC
000231  205                     ADD     L               ;Add to get line number
000232  271                     CMP     C               ;Compare to end of line
000233  332 271 000             JC      LF2             ;If less, go point to next line
000236  315 007 001             CALL    LINES           ;Go get address for scroll
000241  353                     XCHG                    ;Put address into DE
000242  041 100 000             LXI     H,64            ;Get 64
000245  031                     DAD     D               ;Add it to start address
000246  006 100         SETLP:  MVI     B,64            ;Get characters per line
000250  176             LFLOOP: MOV     A,M             ;Load character
000251  022                     STAX    D               ;Store it one line up
000252  043                     INX     H               ;Increment pointers
000253  023                     INX     D
000254  005                     DCR     B               ;Decrease count
000255  302 250 000             JNZ     LFLOOP          ;Loop for this line
000260  015                     DCR     C               ;Decrement line count
000261  302 246 000             JNZ     SETLP           ;Loop for all lines
000264  353                     XCHG                    ;Get end address of last line in DE
000265  033                     DCX     D               ;Adjust by one
000266  303 164 000             JMP     XCNX            ;Go erase last line
                                PAGE
                        ;Here for line feed that does not require scroll.
000271  041 100 000     LF2:    LXI     H,64            ;Get 64
000274  031                     DAD     D               ;Add to cursor address
000275  124                     MOV     D,H             ;Put back high address
000276  175                     MOV     A,L             ;Get low address
000277  346 300                 ANI     ^HC0            ;Adjust to point to line beginning
000301  137                     MOV     E,A             ;Put back in low address
000302  303 073 000             JMP     CURSOR          ;Go do cursor

                        ;Here to erase entire screen.
000305  315 007 001     XFFD:   CALL    LINES           ;Get starting address and line count
000310  345                     PUSH    H               ;Save start address
000311  006 040                 MVI     B," "           ;Get a blank
000313  026 100         STLOOP: MVI     D,64            ;Get characters per line
000315  160             ERLOOP: MOV     M,B             ;Erase this character
000316  043                     INX     H               ;Point next
000317  025                     DCR     D               ;Decrement count
000320  302 315 000             JNZ     ERLOOP          ;Loop for all characters in line
000323  015                     DCR     C               ;Decrement line count
000324  362 313 000             JP      STLOOP          ;Loop for all lines
000327  321                     POP     D               ;Retrieve start address in DE
000330  303 073 000             JMP     CURSOR          ;Go make cursor

                        ;Here to do a bell.  Invert the entire screen.
000333  325             XBEL:   PUSH    D               ;Save cursor address
000334  315 361 000             CALL    INVDIS          ;Invert display
000337  041 000 200             LXI     H,PAUSE         ;Get pause time
000342  055             WAIT:   DCR     L               ;Loop PAUSE times
000343  302 342 000             JNZ     WAIT
000346  045                     DCR     H
000347  302 342 000             JNZ     WAIT
000352  315 361 000             CALL    INVDIS          ;Invert the display again
000355  321                     POP     D               ;Restore cursor address
000356  303 076 000             JMP     CURSR1          ;Go do cursor

                        ;Here to invert the entire display.
000361  041 000 370     INVDIS: LXI     H,TOP           ;Get start address
000364  026 200                 MVI     D,^H80          ;Get a high order bit
000366  016 040                 MVI     C,DISLIN        ;Get lines
000370  006 100         INVLP2: MVI     B,64            ;Get characters per line
000372  176             INVLP1: MOV     A,M             ;Get a character
000373  252                     XRA     D               ;Invert it fast
000374  167                     MOV     M,A             ;Put the character
000375  043                     INX     H               ;Point next
000376  005                     DCR     B               ;Decrement characters per line
000377  302 372 000             JNZ     INVLP1          ;Loop for this line
000402  015                     DCR     C               ;Decrement lines per screen
000403  302 370 000             JNZ     INVLP2          ;Loop for all lines
000406  311                     RET                     ;Return
                                PAGE
                        ;Here to calculate start address in HL and total number of
                        ;lines in C for any display block.
000407  041 000 370     LINES:  LXI     H,TOP           ;Get start address
000412  021 100 000             LXI     D,64            ;Get double byte 64
000415  005             LINELP: DCR     B               ;Decrement start line count
000416  370                     RM                      ;If minus, then all done
000417  015                     DCR     C               ;Decrement stop line count
000420  031                     DAD     D               ;Add 64 to start address
000421  303 015 001             JMP     LINELP          ;Loop for all lines

                        ;Here to invert the video and vice versa.
000424  032             INVCHR: LDAX    D               ;Get character from screen
000425  356 200                 XRI     ^H80            ;Complement high bit
000427  022                     STAX    D               ;Put the character back on the screen
000430  311                     RET                     ;Return from wence we came
000431                          END

[MSONED No errors detected]
[MSOPBK Program break is 000431]

[MSOCPT CPU time used 0:00:03]
```

(The picture on page 83 is labeled as split screen but it is not. It is merely an assembler listing.) In the example on page 82 I have the screen split into four blocks, two each of one line and two larger blocks. The program which is receiving the RTTY calls the display routine using lines 2-11 in its parameter list. Likewise, the transmitter routine calls the display driver using lines 15-31. The two one-line areas are from special function routines which call the display driver with the beginning and end lines defined to be the same.

The cursor function is provided by using the inversion capability of the display. Any character may be displayed as white on black or black on white as described in the March article. The software presented here uses that feature for the cursor and to implement the inaudible bell (invert the entire screen for about a half of a second.)

The cursor address is part of the calling program's parameter list since it is possible (as illustrated above) to have more than one cursor. Use of the display is facilitated by having any routine which uses the display driver to initialize its corresponding display block. This is accomplished by calling the display routine with a form feed (octal 14) in the accumulator. This will erase the specified portion of the display and will initialize the cursor address in the calling routine's parameter block to point to the upper left character of the display block.

The program listing is reasonably well documented so you should be able to follow the program flow without too much trouble.

I do want to mention that in the schematic on page 78 of the March *73* the line labeled "011" (center-left in the schematic) should be labeled C7. Also, the text on the same page says that part of the row counter is a 7490. It is really a 7493 as the schematic indicates.

I wish to express thanks to Victor Kean WA1LKU who took a program listing from my model 19 Teletype, complete with comments in freehand scrawl, and retyped the source and comments on a local DEC-System 10 to produce a readable listing. ■

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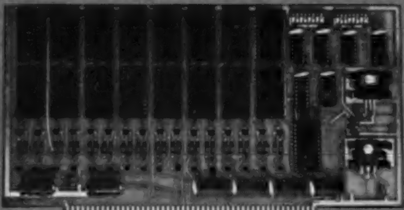

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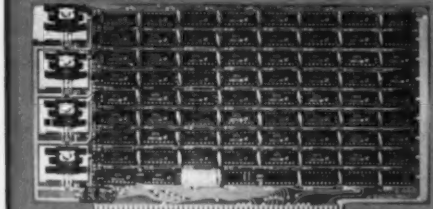

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- Wait States: None.
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H15

KENWOOD ..the Pacesetter in

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KENWOOD 2m ALL MODE TRANSCEIVER
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There's excitement on the 2-meter band and Kenwood's TS-700A is the number one way to get there. There's more than just FM repeaters. SSB DX, OSCAR Satellite, CW. . . and do it all with the TS-700A.

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This companion external speaker provides outstanding audio characteristics for your TS-700A and TS-600.

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RF POWER
AM CAR.
DRIVE
0 — 500 — 1000
TS-600
KENWOOD 6m ALL MODE TRANSCEIVER
POWER SEND CEN NB RIT CAL
OFF REC S OFF
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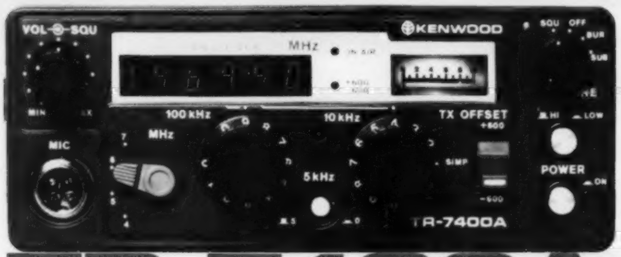
PHONES
MODE
FM CW AM USB LSB

TS-600

VHF



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An easy way to get on the 2-meter band with your TS-520, TS-820, (and most other transceivers.) Simply plug it in and you're on . . . SSB and CW.

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A high performance portable 2-meter FM transceiver that's Kenwood throughout. 146-148 frequency coverage, 12 channels (6 supplied), 2 watts or 400 mW RF output, and provisions for external 12 VDC operation.

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TV-506

Discover the excitement of 6-meters with your TS-520, TS-820, (and most other transceivers) together with the TV-506 transverter. Its 10 watt output will provide you with many hours of enjoyable 6 meter operation.

Want more information? See this fine equipment at an authorized Kenwood dealer or write for detailed specifications.

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TRIO-KENWOOD COMMUNICATIONS INC. 1111 WEST WALNUT/COMPTON, CA 90220

KENWOOD'S

NEW

TS-520S

AND DG-5 DIGITAL FREQUENCY DISPLAY

A NEW STANDARD IN ECONOMY TRANSCEIVERS

The NEW TS-520S combines all of the fine, field-proven characteristics of the original TS-520 together with many of the ideas, comments, and suggestions for improvement from amateurs worldwide. Kenwood's ultimate objectives . . . to make quality equipment available at reasonable prices.

FULL COVERAGE TRANSCEIVER

The new TS-520S provides full coverage on all amateur bands from 1.8 to 29.7 MHz. Kenwood gives you 160 meter capability, WWV on 15.000 MHz., and an auxiliary band position for maximum flexibility. And with the addition of the TV-502 and TV-506 transverters, your TS-520S can cover 160 meters to 2 meters on SSB and CW.

DIGITAL DISPLAY DG-5 (option)

The new Kenwood DG-5 provides easy, accurate readout of your operating frequency while transmitting *and* receiving.

OUTSTANDING RECEIVER SENSITIVITY AND MINIMUM CROSS MODULATION

The new TS-520S incorporates a 3SK-35 dual gate MOSFET for outstanding cross modulation and spurious response characteristics. The 3SK35 has a low noise figure (3.5 dB typ.) and high gain (18 dB typ.) for excellent sensitivity.

NEW IMPROVED SPEECH PROCESSOR

A new audio compression amplifier gives you extra punch in the pile ups and when the going gets rough.

VERNIER TUNING FOR FINAL PLATE CONTROL

A new vernier tuning mechanism allows easy and accurate adjustment of the plate control during tune-up.

FINAL AMPLIFIER

The new TS-520S is completely solid state except for the driver (12BY7A) and the final tubes. Rather than substitute TV sweep tubes as final amplifier tubes in a state of the art amateur transceiver, Kenwood has employed two husky S-2001A (equivalent to 6146B) tubes. These rugged, time-proven tubes are known for their long life and superb linearity.

HIGHLY EFFECTIVE NOISE BLANKER

An effective noise blanking circuit developed by Kenwood that virtually eliminates ignition noise is built-in to the TS-520S.

RF ATTENUATOR

The new TS-520S has a built-in 20 dB attentuator that can be activated by a push button switch conveniently located on the front panel.

VFO-520■ — NEW REMOTE VFO

The VFO-520 remote VFO has been designed to match the styling of the TS-520S and provide maximum operating flexibility on the band selected on your TS-520S.

AC POWER SUPPLY

The TS-520S is completely self-contained with a rugged AC power supply built-in. The addition of the DS-1A DC-DC converter (option) allows for mobile operation of the TS-520S.

EASY CONNECTION PHONE PATCH

The TS-520S has 2 convenient RCA phono jacks on the rear panel for PHONE PATCH IN and PHONE PATCH OUT.

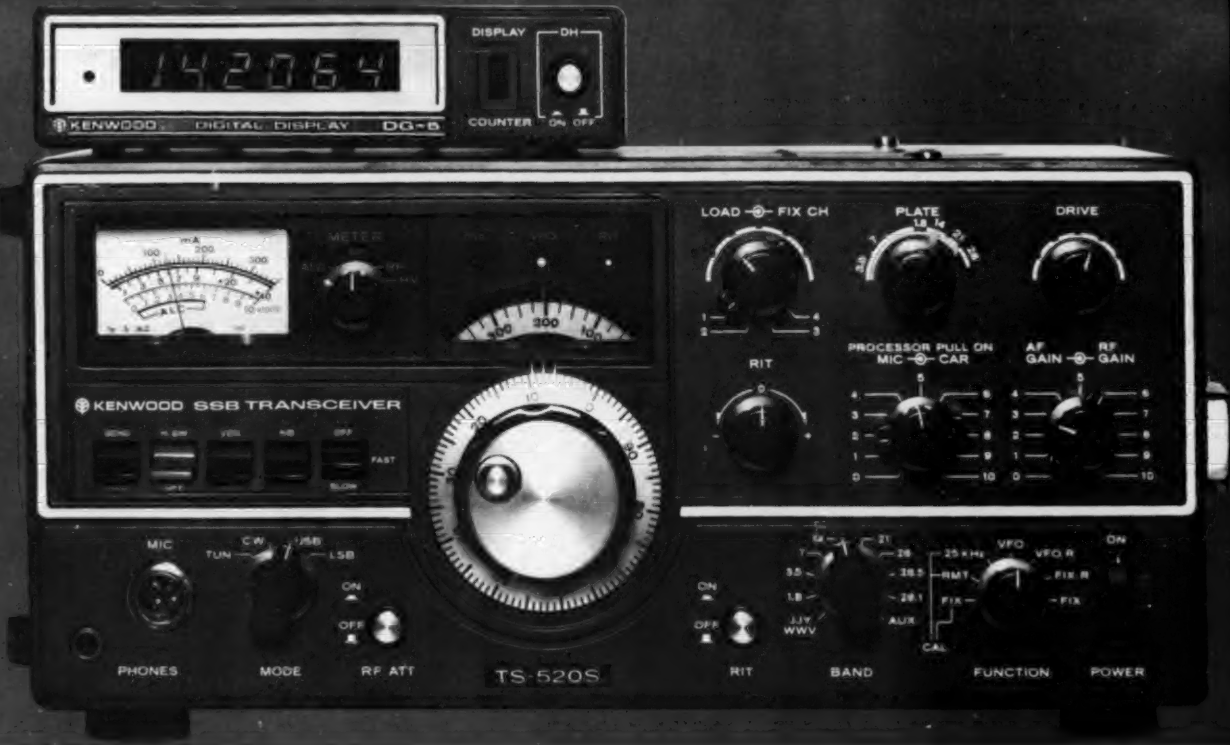
CW-520 — CW FILTER (OPTION)

The CW-520 500 Hz filter can be easily installed and will provide improved operation on CW.

AMPLIFIED TYPE AGC CIRCUIT

The AGC circuit has 3 positions (OFF, FAST, SLOW) to enable the TS-520S to be operated in the optimum condition at all times whether operating CW or SSB.

The TS-520S retains all of the features of the original TS-520 that made it tops in its class: RIT control • 8-pole crystal filter • Built-in 25 KHz calibrator • Front panel carrier level control • Semi-break-in CW with sidetone • VOX/PTT/MOX • TUNE position for low power tune up • Built-in speaker • Built-in Cooling Fan • Provisions for 4 fixed frequency channels • Heater switch.


KENWOOD DIGITAL DISPLAY DG-5
DISPLAY
DH
COUNTER
ON OFF
KENWOOD SSB TRANSCEIVER
LOAD FIX CH
PLATE
DRIVE
METER
RIT
PROCESSOR PULL ON MIC CAR
AF GAIN RF GAIN
MIC
PHONES
MODE
RF ATT
TS-520S
RIT
BAND
FUNCTION
POWER

Specifications

Amateur Bands: 160-10 meters plus WWV (receive only)
Modes: USB, LSB, CW
Antenna Impedance: 50-75 Ohms
Frequency Stability: Within ±1 kHz during one hour after one minute of warm-up, and within 100 Hz during any 30 minute period thereafter
Tubes & Semiconductors:
  Tubes 3
  (S2001A x 2, 12BY7A)
  Transistors 52
  FETs 19
  Diodes 101
Power Requirements: 120/220 V AC, 50/60 Hz, 13.8 V DC (with optional DS-1A)
Power Consumption: Transmit: 280 Watts Receive: 26 Watts (with heater off)
Dimension: 333(13⅛) W x 153 (6-0) H x 335(13- (13-3/16) D mm(inch)
Weight: 16.0 kg(35.2 lbs)

TRANSMITTER
RF Input Power: SSB: 200 Watts PEP CW: 160 Watts DC
Carrier Suppression: Better than -40 dB
Sideband Suppression: Better than -50 dB
Spurious Radiation: Better than -40 dB
Microphone Impedance: 50k Ohms
AF Response: 400 to 2,600 Hz

RECEIVER
Sensitivity: 0.25 uV for 10 dB (S+N)/N
Selectivity: SSB:2.4 kHz/-6 dB, 4.4 kHz/-60 dB
Selectivity: CW: 0.5 kHz/-6 dB, 1.5 kHz/-60 dB (with optional CW-520 filter)
Image Ratio: Better than 50 dB
IF Rejection: Better than 50 dB
AF Output Power: 1.0 Watt (8 Ohm load, with less than 10% distortion)
AF Output Impedance: 4 to 16 Ohms

DG-5

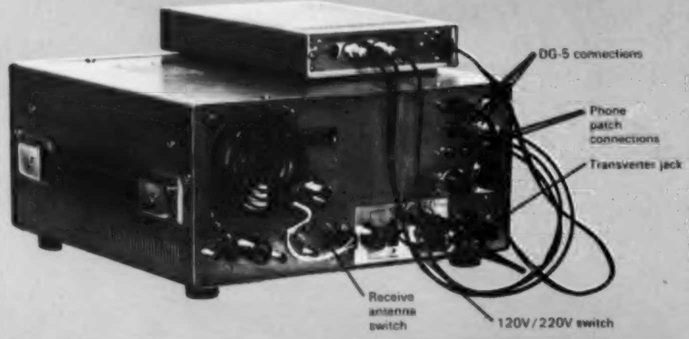
SPECIFICATIONS
Measuring Range: 100 Hz to 40 MHz
Input Impedance: 5 k Ohms
Gate Time: 0.1 Sec.
Input Sensitivity: 100 Hz to 40 MHz . . . 200 mV rms or over, 10 kHz to 10 MHz . . 50 mV or over
Measuring Accuracy: Internal time base accuracy ±0.1 count
Time Base: 10 MHz
Operating Temperature: -10° to 50° C/14° 122° F
Power Requirement: Supplied from TS-520S or 12 to 16 VDC (nominal 13.8 VDC)
Dimensions: 167(6-9/16) W x 43(1-11/16) H x 268(10-9/16) D mm(inch)
Weight: 1.3 kg(2.9 lbs)

DG-5
(optional)

KENWOOD DIGITAL DISPLAY DG-5
DISPLAY
DH
COUNTER
ON OFF

The luxury of digital readout is available on the TS-520S by connecting the new DG-5 readout (option). More than just the average readout circuit, this counter mixes the carrier, VFO, and heterodyne frequencies to give you your exact frequency. This handsomely-styled accessory can be set almost anyplace in your shack for easy to read operation . . . or set it on the dashboard during mobile operation for safety and convenience. Six bold digits display your operating frequency while you transmit and receive. Complete with DH (display hold) switch for frequency memory and 2 position intensity selector. The DG-5 can also be used as a normal frequency counter up to 40 MHz at the touch of a switch. (Input cable provided.)

NOTE: TS-520 owners can use the DG-5 with a DK-520 adapter kit.


DG-5 connections
Phone patch connections
Transverter jack
Receive antenna switch
120V/220V switch

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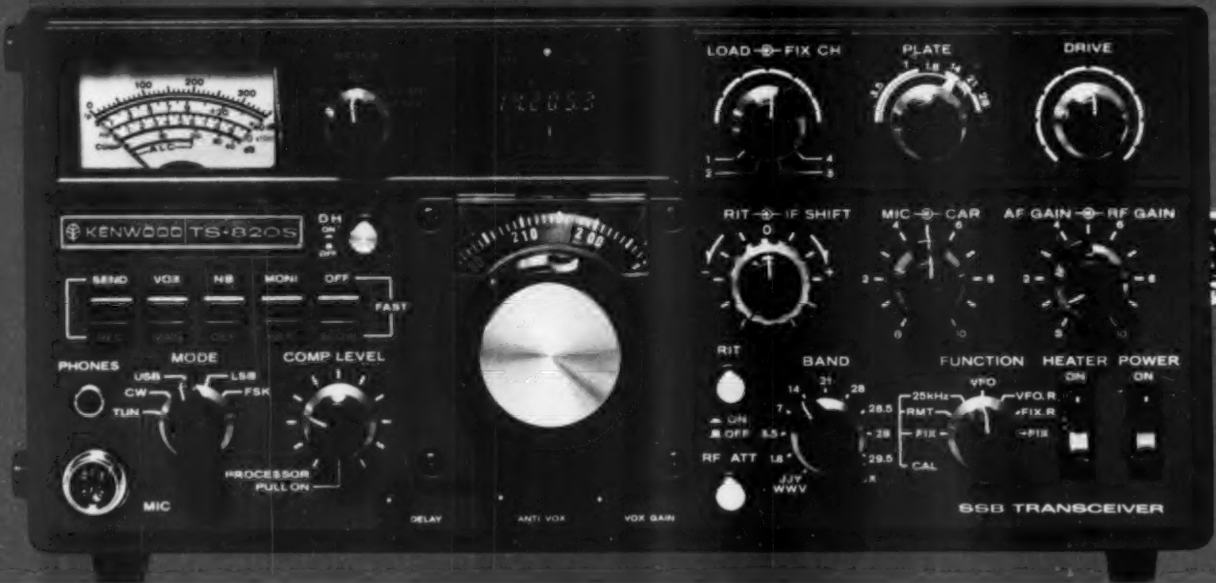
TS-820S



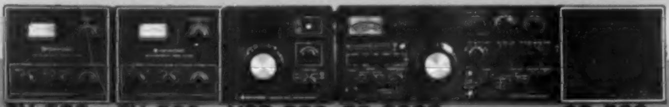
We told you that the TS-820 would be the best. In little more than a year our promise has become a fact. Now, in response to hundreds of requests from amateurs, Kenwood offers the TS-820S* . . . the same superb transceiver, but with the digital readout factory installed. The worldwide demand for the TS-820 far exceeded our initial production plans. However, production capacity has been substantially increased and our objective is to make the TS-820S more readily available to you. As an owner of this beautiful rig, you will have at your fingertips the combination of controls and features that even under the toughest operating conditions make the *TS-820S the Pacesetter that it is.*

Features

Following are a few of the TS-820S' many exciting features.

SPEECH PROCESSOR • An RF circuit provides quick time constant compression using a true RF compressor as opposed to an AF clipper. Amount of compression is adjustable to the desired level by a convenient front panel control.

IF SHIFT • The IF SHIFT control varies the IF passband without changing the receive frequency. Enables the operator to eliminate unwanted signals by moving them out of the passband of the receiver. This feature alone makes the TS-820S a pacesetter.



PLL • The TS-820S employs the latest phase lock loop circuitry The single conversion receiver section performance offers superb protection against unwanted cross-modulation. And now, PLL allows the frequency to remain the same when switching sidebands (USB, LSB, CW) and eliminates having to recalibrate each time

DIGITAL READOUT • The digital counter display is employed as an integral part of the VFO readout system. Counter mixes the carrier, VFO, and first heterodyne frequencies to give *exact* frequency. Figures the frequency down to 10 Hz and digital display reads out to 100 Hz. Both receive and transmit frequencies are displayed in easy to read, Kenwood Blue digits.

Specifications

FREQUENCY RANGE: 1.8-29.7 MHz (160 - 10 meters)
MODES: USB, LSB, CW, FSK
INPUT POWER: 200W PEP on SSB
180 W DC on CW
100 W DC on FSK
ANTENNA IMPEDANCE: 50-75 ohms, unbalanced
CARRIER SUPPRESSION: Better than -40 dB
SIDEBAND SUPPRESSION: Better than -50 dB
SPURIOUS RADIATION: Greater than -60 dB (Harmonics more than -40 dB)
RECEIVER SENSITIVITY: Better than 0.25uV
RECEIVER SELECTIVITY:
SSB 2.4 kHz (-6 dB)
4.4 kHz (-60 dB)
CW* 0.5 kHz (-6 dB)
1.8 kHz (-60 dB)
*(with optional CW filter installed)
IMAGE RATIO: 160-15 meters: Better than 60 dB 10 meters: Better than 50 dB
IF REJECTION: Better than 80 dB
POWER REQUIREMENTS: 120/220 VAC, 50/60 Hz, 13.8 VDC (with optional DS-1A DC-DC converter)
POWER CONSUMPTION: Transmit: 280 Watts Receive: 26 Watts (heaters off)
DIMENSIONS: 13-1/8" W x 6" H x 13-3/16" D
WEIGHT: 35.2 lbs (16 kg)

VFO-820
Function switch provides any combination of transmit/receive/transceive with the TS-820S. Both are equipped with VFO indicators showing which VFO is in use.

SP-520
Although the TS-820S has a built-in speaker, the addition of the SP-520 provides improved tonal quality. A perfect match in both design and performance.

TV-502
The TV-502 transverter puts you on 2-meters the easy way. Operates in the 144.0-145.7 MHz frequency range with a 145.0-146.0 MHz option. Completely compatible with the TS-820S, the TS-520S and most any HF transceiver.

TV-506
Similar to the TV-502 except that it opens up the 6-meter band (50.0-54.0 MHz) to your HF rig.

*The TS-820S and DG-1 are still available separately.

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QSL Tips

-- how to bat 1.000

Marty Barrack
200 S. Lincoln
Sterling VA 22170

This month we interview Sir Henry Peter Fox, the world's greatest authority on QSL cards. Sir Henry works as a gun bearer on the Dark Continent, keeping the natives restless. He used to teach marksmanship until one of his students, Albert Scaramanga (known to his CB buddies as the Triple Nipple), tried to shoot a member of the British Secret Service. Ruddy awful business! After that, Sir Henry turned to QSL collecting. When we approached he was explaining to one student how to tell from looking at the edge of a QSL where the tree from which it came grew and the time of year it was cut down. In response to another question he named every ham in the world from memory, how many countries he had confirmed, and exactly how many cards he had outstanding and at which bureaus. I asked Sir Henry how to get a lot of QSL cards. He replied, "Get a CB and wait until 1980." I explained that we were interested in ham QSLs. "Oh," he said, "order from Brownie by the thousand." I tried again. "No. Already filled out." "Ah, why didn't you say so? Rob a QSL Bureau."

Sir Henry downed a Bud and continued, "There are two ways to get QSL cards after you work a station. You can send your card directly to the station you worked, or you can send it through the bureaus." I asked why go through all the intermediary bureau stages. His answer was strikingly clear. "Money." He explained that, to send a card directly, you have to fill in the data, look up the DX station's name and address in the callbook, and type it on a 9½" envelope. Then you type your own name and address on a 6½" envelope. If you can get it, put sufficient air postage in the stamps of the DX country on the small envelope. Otherwise, put several International Reply Coupons in the large envelope. Also put in the large envelope your QSL card, properly filled in, and the small envelope. Then put sufficient U.S. stamps on the large envelope and mail it promptly. Odds are such a mailing will cost about two dollars in IRCs and stamps for just one card.

I told him it seemed very expensive. He opened another ice cold Bud and went on. "It is. But it's fast. You have to decide for yourself whether the speed is worth it. Usually, if you have a small station and only work DX occasionally, you may as well get your souvenir fast and direct. But if you work 'em three a minute, your costs will go out of sight. Now, the bureau system will do the job slower, but for a fraction of a penny per card! Start by filling in all your cards, just the data section, don't address them. Then put them in alphabetical order by prefix. Put the cards in a box with a dollar and a copy of a current *QST* mailing label and address it to Outgoing QSL Bureau, ARRL, 225 Main St., Newington CT 06111.

"ARRL sorts the cards and mails a bundle off to each foreign bureau every week. Then it takes 30-90 days for the surface mail to travel from ARRL to the foreign bureau. Then figure 30-90 days for the foreign bureau to sort it and get it to the foreign ham you worked. The ham will probably take about 30 days to actually fill in his card for you and send it back to the foreign bureau. The foreign bureau may take another month to six months to get it on a boat; the big foreign bureaus such as DL, G, YU, F, ON, etc., will usually get a card out within a month. Then figure another 30-90 days on the high seas before the card gets back to the U.S. Then it goes to a U.S. bureau. The fellows in the bureaus, by the way, are the real unsung heroes of DXing. They do a super job of sorting. Every DXer in the call area keeps a 5" x 7" manila envelope, self addressed and with 13¢ postage stuck on and another 13¢ stamp clipped on, on file. The bureau man with your letter puts all the cards addressed to you in your envelope. When the weight of the envelope approaches the maximum postage limit, the bureau mails it off full of cards you earned the year before!"

"Will they really do the same job?" I asked. He fondled the beautiful woman sunbathing at his side and said, "Look at two guys in the Sterling Park club. WA4HPF has 260 countries confirmed and spent about $200 in IRCs. K4VT has 260 countries confirmed and never spent a dime. Of course, K4VT has been around a lot longer."

I asked Sir Henry how many countries he had. "Eleven," he replied proudly. I told him it seemed a small number compared with N4KW's 300+ countries, and asked if N4KW was a better operator. "You asked how many countries I had," he answered. "I *own* eleven countries. I have QSLs from every country, naturally."

I questioned Sir Henry about the practice of putting a dollar bill in with a directly sent QSL to encourage the DX to send his card in return. "Yes," he said, "some of the less experienced fellows do that. The sharp boys know how to do it right. You open an irrevocable letter of credit with a bank in the DX station's country. When the DX station sends off the card the bank releases a draft to the DX operator."

The sun was starting to set. Its orange light reflected off Sir Henry's station, especially the shiny black Collins HF-80s. Outside I could see W6AM patiently waiting to ask Sir Henry Peter Fox how to work DX and get QSLs. I shook Sir Henry's hand warmly, wished him well, and took out the ropes and pitons for the long trip down. ■

Matthew T. Lewis VE7CHI
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TRIUMF – UBC
4004 Wesbrook Mall
Vancouver BC V6T 1W5

CB to 10

-- part III: converting the TRC-47

With the slowdown in the CB boom and the recent expansion to 40 channels, the CB equipment manufacturers have been caught off guard with thousands of 23 channel radios in warehouses. These are being dumped on the market at very low prices. I've seen advertisements as low as $39.95 for a 23 channel AM rig. A very good one can be had for well under $100.00.

Most of these radios are very easily converted to ten meters at a cost of under forty dollars.

First, for those of you not familiar with the way these crystal synthesized rigs operate, a few basics, then I will go into specific details of the conversion of a Radio Shack TRC-47, a very common AM & SSB rig.

There are two basic 23 channel synthesizer schemes, the 14 crystal and the 12 crystal. First the 14 crystal type, the more common.

The 14 crystal radios usually have a single conversion receiver with an i-f of 455 kHz. The crystals are in three groups which I will call group A, group Bt, and Br. In my example, I will use the following crystal frequencies: group A – 16.465, 16.515, 16.565, 16.615, 16.665, 16.715; group Bt – 10.500, 10.510, 10.520, 10.540; group Br – 10.955, 10.965, 10.975, 10.995.

In operation, one crystal from group A is used, and one from group Bt on transmit and one from Br on receive. For example, on channel 1 (26.965 MHz) on transmit, 16.465 and 10.500 are mixed to get the operating frequency, and on receive 16.465 and 10.955 are mixed to get 27.420 MHz, which conveniently just happens to be 455 kHz above the operating frequency of 26.965. So if we add 1.735 MHz to each crystal in group A, we can get frequencies in the range of 28.700 to 28.990 MHz, with channel 9 working out to 28.800, the AM calling frequency. How about that?

So, with a 14 crystal AM rig, all that has to be done to put it on ten is to change six crystals and retune some coils. With minimal test equipment, a VTVM, signal generator (that old VFO), a wattmeter or swr bridge, and a dummy load, the whole job can be done in under one hour.

The most difficult part of the job is figuring out what crystals to order. Table 1 is a chart of the common heterodyne scheme and channel frequencies. Notice the 10-10-20-10 kHz spacing of the channels.

Note the channel marked ** is indicated by the dot on the dial between 22 and 23 and on some radios can be had by just installing a jumper or clipping one. Some other radios would require major mechanical modifications to the channel switch to get it.

When you decide what frequencies on ten meters you want, on the 10-10-20-10 spacing pattern, just subtract 26.965 from the lowest one and add this result to the frequency of each crystal in group A, order the new crystals from your favorite purveyor of quartz, wait for the post office, wait for the post office some more, and, when they come, get out the old trusty soldering iron and swizzle sticks, and soon you'll be on ten.

Now, for the 12 crystal rigs. These are cheaper to convert, as only 2 have to be changed. The receivers in these are usually better because they are dual conversion. The heterodyning scheme here is similar to the 14 crystal type but there are only 6 group A and 4 group B crystals, and 2 i-f crystals. Table 2 is an example from a Sanyo TA-923 which I still use on 11 meters.

In this type of radio, one crystal from group A and one from group B are used for both transmit and receive and are mixed to form a product in the 38 MHz range which is run through a bandpass filter at this frequency.

An example for channel 09 (27.065 MHz): Grp A = 23.390; Grp B = 14.950; A + B = 38.340 MHz.

On transmit this 38.34 MHz is mixed with 11.275 to get the operating frequency of 27.065, run through a bandpass filter at 27 MHz, amplified, and modulated. On receive, the 38.34 is injected into the first mixer to get the Rx first i-f at 11.275, which is then mixed with the 11.730 to get the second i-f of 455 kHz. Simple, isn't it? All that has to be done here is to lower the 11 MHz crystals by the amount you want to go up in operating frequency. For example, to make channel 09 come out on 28.800 lower them by 1.735 MHz making the Tx i-f = 9.540 MHz and the Rx i-f crystal = 9.995 MHz, retune the appropriate coils, and you're on the air on ten.

Now, down to the real nitty-gritty of one that I have had on the air on SSB for several months now, in use both at home and in the car. The one I picked is a Radio Shack TRC-47, about the same size as an Icom IC-22. It has a very good crystal filter centered at 11.2735 MHz which gives about 50 dB unwanted sideband suppression. The TRC-48 uses the same filter and oscillator PC board, so conversion data for it is identical to the TRC-47. The TRC-48 is slightly larger and fancier (it has an "S" meter, PA, and switchable noise blanker) and more expensive. They are both rated at 4 Watts rf output on AM and 12 Watts PEP on SSB. I am getting 10 Watts PEP out of mine on 28.600

Grp A/Grp Bt	10.500	10.510	10.520	10.540
16.465	26.965-01	26.975-02	26.985-03	27.005-04
16.515	27.015-05	27.025-06	27.035-07	27.055-08
16.565	27.065-09	27.075-10	27.085-11	27.105-12
16.615	27.115-13	27.125-14	27.135-15	27.155-16
16.665	27.165-17	27.175-18	27.185-19	27.205-20
16.715	27.215-21	27.225-22	27.235-**	27.255-23

Table 1.

MHz. That's only 10 dB down from the typical SSB exciter which has at best 100 Watts output, most of them more like 70 or 80 on ten meters. So what if I'm 1 or 2 "S" units down; it makes up for all the mobile noise from my own and other cars on the road. If I can hear them in the car, I can work them.

Now, how to do it to it.

Step 1: Getting the radio — new or used?

If you have a bit of test equipment you can probably get a better deal on a used radio, but check it out first! Check rf output on AM. If below 2.5 W or above 5.5 W when operated on 13.5 V dc or the ac line if a base station, forget it and go on to the next one. On SSB the output should indicate 8-16 Watts when you whistle into the mike. Check out the receiver on an antenna. Find a few strong local signals and make sure they disappear when switching to the next channel on either side. They should be way down when switching sidebands if SSB.

Next, take the covers off and have a good look inside for modifications. If you see any, put the covers back on and forget it, unless it is quite obvious that the mods will not affect operation of the radio in the manner in which it was designed to operate. As far as dust, dirt, and smudges go, they can easily be cleaned up, so don't let that bother you. Look for ads in the newspaper or in the local weekly *Buy and Sell*. Bargain over price as most sellers are not firm on asking price, and, after all, it's a buyer's market now for 23 channel radios, especially for SSB. Make a call to the local police to make sure it's not hot. For a new radio, shop around at a few stores. Again, it's a buyers market, and even at the chain stores you can get quite a good deal. So make an offer; they might just take it.

Step 2: Figuring it out

If at all possible, get the service manual! This will tell you all you ever wanted to know, but were afraid to ask. For the Radio Shack radios, it can be ordered from the store (they're everywhere just like MacDonald's) if they don't have an extra one in stock. It's well worth the two bucks. Most radios have a schematic diagram in the owner's manual, and some even have one glued inside the top cover. This may be all you need, but the service manual gives complete alignment information and a description of circuit operation which can help a lot.

Group A:	23.290	23.340	23.390	23.440	23.490	23.540
Group B:	14.950	14.960	14.970	14.990		
Tx i-f:	11.275					
Rx i-f:	11.730					

Table 2.

Step 3: Plotting and Scheming — just what has to be done?

Which crystals to change? Determine the type of synthesizer and do the arithmetic. If you have trouble, write me enclosing a copy of the schematic and existing crystal frequencies and one SASE, and I will be glad to help you. Next, order the new crystals and wait, and wait.

What about tuning on SSB? All the SSB rigs have a clarifier control which will move the receiver + or - about 1 kHz. On many of the rigs it also moves the transmitter the same amount. Don't worry if it doesn't move the Tx; it's easy to fix it so it will. What about moving more than 1 kHz? If you can't figure it out, ask one of the unscrupulous CB servicemen who advertize in the personal column of the local newspaper how to put in a slider. This will give you about a 20 kHz spread on each channel. Follow all signal paths on the schematic so you can figure out which circuits will need retuning.

Step 4: The Mod Squad Attacks

For the TRC-47 (and -48), which uses sort of a cross between the 12 and 14 crystal synthesizers, the existing crystals are shown in Table 3.

In this scheme, one crystal from group A is always used, one from group Bu for AM and USB, and one from group B1 for LSB only. The 11.275 is used for AM Tx and for USB. The 11.272 is used for LSB, and the 11.730 for AM Rx only.

Change the group A crystals to: 24.865, 24.915, 24.965, 25.015, 25.065, and 25.115 MHz. The clarifier control is a fairly large variable capacitor of two sections, with a fixed capacitor in parallel with each section. Clip these two fixed capacitors out of the circuit. This now gives you more range on the clarifier, about -1 to +4 kHz. Seeing as how nobody uses LSB on ten meters, remove the two resistors (1 K) which bias the diodes for switching the BFO crystals and short the diode for the USB BFO crystal (11.275). By doing this, when you move the mode switch to LSB the radio stays on USB, but you get a downward frequency shift of about 3 kHz. You now have two 5 kHz wide bands with a 2 kHz overlap for each of the 23 channels. Now retune the bandpass filters at 38 and 27 MHz to 39.6 and 28.6 MHz, peak the receiver front end, peak the transmitter driver and final coils. Do not adjust any of the pots in the transmitter unless you have access to and can use a spectrum analyzer, as this will affect drive level and bias and will affect intermodulation distortion just as much if not more than it will affect power output. The extra one or two dB you can get, just isn't worth the trouble.

Step 5: The Smoke Test

Get in contact with a local ham who can work ten meters, and arrange a sked to make sure that it is working on the frequency you think it is, and while he is transmitting on a known frequency, make sure you can tune him in where you think he should be. Then and only then, try out the transmitter to see if he can hear you. Also have him tune up and down the band to make sure you are only transmitting in one place and the radio has reasonably good audio quality. If you want to use an external speaker on it, be careful how far you advance the audio gain, as these rigs have much more audio than you will probably ever need on receive, as the Rx audio output is also the AM modulator. It will give you up to 5 Watts of audio, enough to wake the silent keys. They usually have resistors in series with the internal speaker to prevent the voice coil from smoking at an early age.

Step 6: Operating it, CQ CQ 10 CQ 10 CQ 10-10, etc.

Generally accepted calling frequencies are 28.600 USB and 28.800 AM, and activity seems to be centered about these, but it's best to check with a local who is active on ten to make sure first. There may be a local net or club using some other frequency

Group A:	23.330	23.380	23.430	23.480	23.530	23.580
Group Bu:	14.910	14.920	14.930	14.950		
Group B1:	14.907	14.917	14.927	14.947		
BFO u:	11.275	**BFO 1:** 11.272	Rx 2nd mixer for AM only 11.730			

Table 3.

that you may want. On many of these radios the squelch control works very well, so it's easy to monitor a specific frequency for calls, and have things quiet when there is no signal present, just like two meter FM. Local coverage, both mobile and fixed, seems to be about the same as two meter simplex operation, but more fun when it opens up, which is getting to be more often now that the sunspot cycle is on the upswing again.

Some Notes on Antennae for Ten.

For mobile operation I use one of the four foot long top loaded fiberglass whips with 12 turns removed from the top of the coil. This makes it resonate nicely at about 28.6 MHz. It's only about 1.5 dB down from a full quarter wave, and it's a lot easier to fit into the garage.

At home I use a Radio Shack 5/8 wave ground plane for 11m with the capacity hat removed, but everything else exactly as it comes out of the box and assembled following the directions. Removing the top hat (3 wires) makes it resonate at about 28.5 MHz with an swr of less than 1.4:1, not bad for an antenna which takes only about 15 minutes to assemble and erect.

What About Crystals?

They can be had from any of the manufacturers advertising in the magazine elsewhere, or you just may have some in your junk box. Canadians can order from Lesmith Ltd., PO Box 703, Oakville, Ont., at a price of six dollars per crystal. Delivery of crystals should take 4-6 weeks.

Best of luck, and hope to hear you on ten. If you have any trouble be sure and drop me a line, and I will try to help you out. ■

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CB to 10

- - part IV: Johnson 123A mod

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As any fool can plainly see, the transceiver shown in Fig. 1 is a very common, midpriced CB unit. Right? Wrong. This particular E. F. Johnson Messenger 123A started out that way, but a few simple modifications have turned it into a 23 channel, crystal controlled 10 meter amateur rig.

When we were finished with the modification and tuning, we ran a performance check on this unit. Radio frequency output exceeded 3.5 Watts and receiver sensitivity was on the order of 0.5 microvolts for 10 dB signal plus noise/noise. That ain't bad. With the coming increase in sunspot activity, conversions such as this should be good for some very interesting low power DX.

The idea was sparked by the realization that many underpriced CB units were made available when the CB manufacturers began dumping 23 channel units to make room for the 40 channel models. An amateur with only basic skills should be able to buy and convert a 23 channel CB unit to 10 meters for less than $80 – of course, if the unit chosen for conversion is more exotic and costs more to begin with, the total price can be much higher.

Our primary reason for choosing the 123A over other models was simple . . . we had an extra one gathering dust on the shelf. We could have used practically any unit on the market, and so can

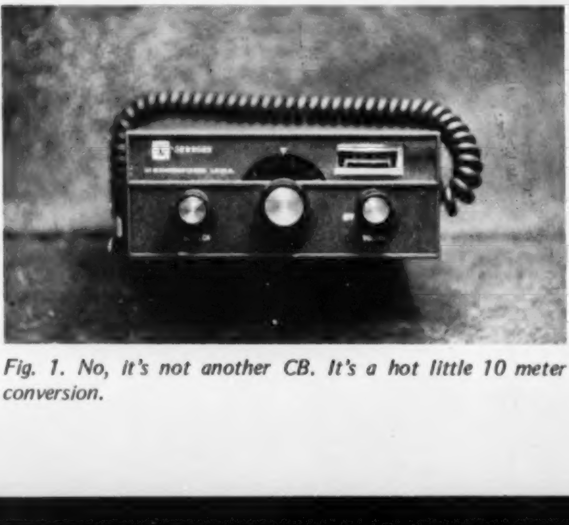

Fig. 1. No, it's not another CB. It's a hot little 10 meter conversion.

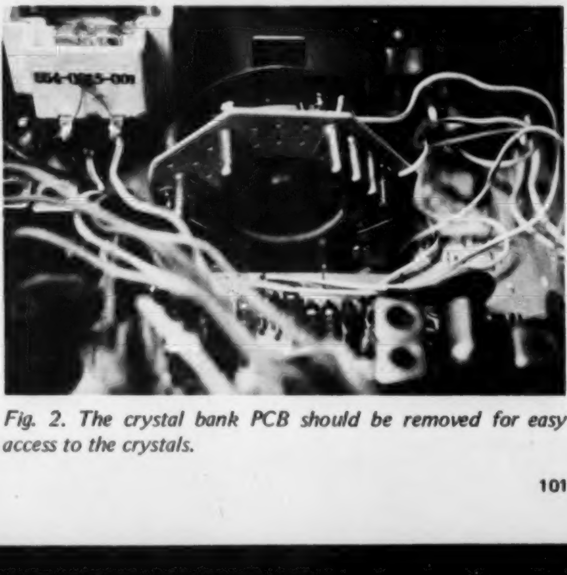

Fig. 2. The crystal bank PCB should be removed for easy access to the crystals.

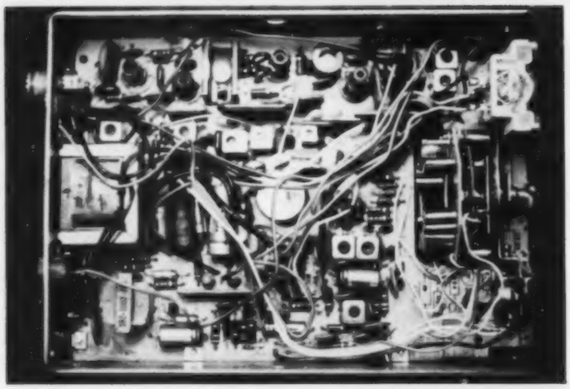

Fig. 3. Interior shot of the 123A showing the transmitter strip at the top.

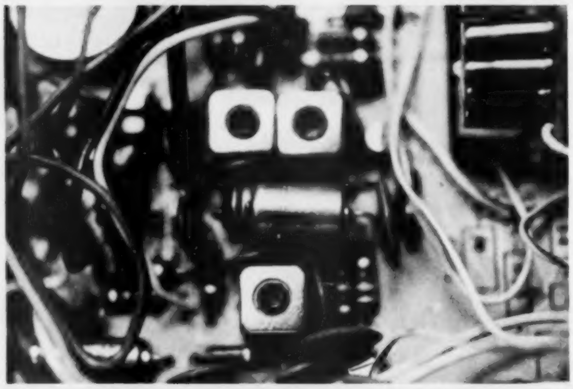

Fig. 4. Detail of the oscillator synthesizer mixer tuning adjustments and test points.

you. However, let's go through this particular conversion step-by-step, since most conversions will differ only in minor details. If you follow what we did here, you should have no trouble with other makes or models.

The 123A is a single-conversion synthesized unit using a channel frequency minus 455 kHz input to the receiver mixer. This is accomplished by mixing the output from a high frequency oscillator with that of a low frequency oscillator and using the difference frequency.

For example, when the unit is tuned to CB channel 1 (26.965 MHz), the high frequency oscillator operates at 32.700 MHz. The low frequency oscillator on channel 1 operates at 6.190 MHz. The difference frequency is 26.510 MHz, which is 0.455 MHz below the channel frequency.

When the unit is switched to the transmit mode — still on channel 1 — the high frequency oscillator continues to operate at 32.700 MHz, but the low frequency oscillator has a 5.735 MHz crystal switched into the circuit and the 6.190 MHz crystal is switched out. This new difference frequency — 26.965 MHz (same as the channel frequency) — is simultaneously switched to the transmitter strip, and the receiver is muted.

While the 123A is a 23 channel unit and only uses 14 crystals in all, each crystal must control several channels. If you start at the lower end of the band (channel 1) and change channels all the way to the top (channel 23), you will find that the high frequency crystals are switched after four consecutive channels and the low frequency crystals are switched for each channel and repeat every fourth channel. Table 1 should make that clearer.

We decided that since we had to start somewhere, a frequency jump of exactly 2 MHz would simplify matters, so that is what we used. It would have been as good from an operating standpoint to shift the low frequency crystals, but for economy we decided that it made much more sense to change only six crystals rather than eight. (Another reason to use the higher oscillator for changes is that low frequency oscillators are sometimes pretty narrow banded. We didn't want to have to change any tuning components if we didn't have to do so.)

By referring to Table 1, you can see that to raise receiver and transmitter frequencies 2 MHz, you simply raise the high frequency oscillator 2 MHz. The new difference frequencies (28.965, etc.) fall into the 10 meter phone band.

We ordered the new crystals and put the unit back on the shelf until they arrived. When they finally got in after several weeks, we took the unit out of the case and began the conversion.

Removing the crystal bank — it surrounds the channel selector switch — in the 123A is a relatively simple matter of taking off the front panel knobs, the four screws which secure the front panel to the chassis, and the two tiny bolts which fasten the crystal bank to the channel selector switch. In Fig. 2 you can see one of the nuts which holds the crystal bank located at the left center of the picture.

When the fiber PCB which holds the crystals is loose, it is a simple matter to remove the high frequency oscillator crystals and replace them with the new crystals. Use a good clean iron for the job in order to minimize damage to the PCB.

When all of the new crystals are soldered in place and the leads trimmed, reassemble the whole mess and you are ready to start tuning.

Tuning can be very simple if you have the right equipment. If you don't, we would suggest that you borrow it. In this case the right equipment is a diddlestick and an rf VTVM.

Look at Fig. 3. Slightly to the right and below center you can see two tiny transformers. Below them you will see one more. The lower transformer sitting all by itself is T7. Transformer T7 tunes the output of the high frequency oscillator.

Fig. 4 is an expanded view of T7 and its associated components. Just to the right of T8 and T9 is transistor Q14, the synthesizer mixer. The output from the high frequency oscillator is coupled through T7 to the emitter of Q14. With the unit in the receive mode, connect the rf probe to the emitter of Q14 and tune T7 for maximum. The reading should be somewhere between 0.5 and 1.0 volts rms of rf. After you have tuned T7 for maximum, switch through all of the channels. If you are measuring the right output, after every four channels the reading will momentarily dip as you switch in another crystal. When you turn the channel selector to the blank space between channels 22 and 23, the reading should go to zilch In this unit, as in many others, the channel selector switch has a cutout to prevent operation in this position. (It used to be called channel 22a, 27.235 MHz, which was illegal under the old CB rules.)

After you are satisfied that the oscillator is working properly, move the rf probe to the diodes to the left of the filter capacitor directly above T7. The cathodes of these two diodes are connected, and this is your next test point. Tune T8 and T9 for maximum at this point. You may have to go back and touch up T7 as you load it by tuning T8 and T9.

If you get something between 0.3 and 0.5 volts rf at this test point, it is downhill all the way from here. If not, go back and start over again at T7.

In Fig. 3 you can see two small transformers above the channel selector. These are T10 and T11. To tune them, connect the rf probe to the collector of rf pre-driver Q15 (in Fig. 3 Q15 is obscured by the mike cord, but it is the first transistor in the transmitter strip and is close to T10/T1). When the probe is connected, connect a dummy load to the rf output of the unit and key the mike. The rf output measured on the collector of Q15 should be several volts. If you have it, move the probe to the next transistor in the transmitter strip and tune each stage for maximum before going on to the next. By this time, you should have a Watt or two of rf at the transmitter's output, and you can complete tuning with a wattmeter if you have one – and you either do or have a friend who does.

Before you do any receiver tuning, complete the transmitter tuning. When you are finished, you should have 3.0 Watts or more at 13.6 volts dc input. Transformers T10/T11 may need to be stagger-tuned to optimize output on all channels. All other transmitter tuning should be done at or near the center of the band (channel 12 or 13). After you have maximum output, whistle into the mike. The wattmeter will probably kick down. If you have tuned to maximum, you may be showing as much as 5.0 Watts of output. The 123A will usually not modulate that much power fully and transmitter tuning should be touched up a little.

Between the rf final amplifier and the output connection you can see two tuning coils. After the unit has been tuned to maximum, insert a diddlestick into the coil nearest the final amplifier. Using short whistles, turn the slug clockwise into the coil until the wattmeter begins to kick up slightly on the peaks. Then go to the last tuning coil and retune it for maximum output. Do this back and forth until you have the maximum output which will allow the wattmeter to show a slight kick upwards on peaks. If this point happens to be in excess of 5 Watts, fine. If it is less – and it probably will be – that's okay too. In any event, that point is where the unit should operate for cleanest, best modulated output.

Now you are ready to tune the receiver section. Assuming that the unit was working properly on CB frequencies, you have only two minor adjustments to make.

Look at Fig. 3 again. Directly below and parallel to the transmitter strip is the receiver rf and i-f strip. Don't disturb any adjustments except those of the two cans closest to the rear of the chassis. The can sitting by itself near the modulation transformer is T1, the receiver rf input tuning. The next can in the line is the mixer input tuning, T2. There are two easy ways of tuning these two cans.

If you have a stable signal source and can be certain that it is on frequency, set it for 29.085 MHz (new channel 11-10m), couple it to the transceiver and tune for maximum output or S-meter reading.

The other way is to connect the unit to an antenna which exhibits a low vswr on 10 meters and tune for maximum noise. Normal precautions against tuning to an image frequency should be observed. As a general rule, if you tune to the first peak that you come to from the original positions, you will be right on the money the first time. Measure the output frequencies with a counter, check it out with a friend across town, and you are on the air. Total time involved? A couple of hours.

In our prototype unit, we noticed only one unusual item. On channel 4-10m (you have to call them something), we have a relatively strong received signal present even when the antenna is not connected. Since we have 22 other channels to use, we decided to forget it and not go looking for spurs. The same problem may or may not show up on your conversion.

As mentioned before, we chose this unit simply because we had it. If you have another make or model, your conversion may be a little harder. If the crystals are of the plug-in type, the conversion may be easier. When you begin to tune the unit, take it one step at the time. Few if any CB units will operate at a new frequency without careful retuning.

The 2 MHz jump seems to be a good idea to us. Channelization means that mobile operation is simple and fiddle-proof. As a suggestion, it seems to us that channel 1-10m (29.965 MHz) would be a good calling channel. If everyone who makes a +2 MHz conversion monitors this channel as the band opens this summer and fall, there should be a good chance of making contacts. If everyone jumps around all over the band, the chances go way down. Be seeing you on 10. ■

CHANNEL	HF CRYSTAL	RECEIVE LF CRYSTAL	RECEIVE OUTPUT	TRANSMIT LF CRYSTAL	TRANSMIT OUTPUT
1	32.700	6.190	26.510	5.735	26.965
2	32.700	6.180	26.520	5.725	26.975
3	32.700	6.170	26.530	5.715	26.985
4	32.700	6.150	26.550	5.695	27.005
5	32.750	6.190	26.560	5.735	27.015
6	32.750	6.180	26.570	5.725	27.025
7	32.750	6.170	26.580	5.715	27.035
8	32.750	6.150	26.600	5.695	27.055
9	32.800	6.190	26.610	5.735	27.065
10	32.800	6.180	26.620	5.725	27.075
11	32.800	6.170	26.630	5.715	27.085
12	32.800	6.150	26.650	5.695	27.105
13	32.850	6.190	26.660	5.735	27.115
14	32.850	6.180	26.670	5.725	27.125
15	32.850	6.170	26.680	5.715	27.135
16	32.850	6.150	26.700	5.695	27.155
17	32.900	6.190	26.710	5.735	27.165
18	32.900	6.180	26.720	5.725	27.175
19	32.900	6.170	26.730	5.715	27.185
20	32.900	6.150	26.750	5.695	27.205
21	32.950	6.190	26.760	5.735	27.215
22	32.950	6.180	26.770	5.725	27.225
23	32.950	6.150	26.800	5.695	27.255

Table 1. Synthesizer scheme. If 2 MHz is added to each frequency in the HF Crystal column, the Receive output and Transmitter output also increase by 2 MHz. NOTE: All frequencies in MHz.

Tommy M. Murphy K5UKH
Route 1, Box 310A
Ethel MS 39067

CB to 10

-- part V:

converting the Hy-Gain 670B

As a result of the recent dump of 23 channel Citizens Band radios on the market in anticipation of a big push for the new 40 channel units, there are many 23 channel units at real bargain prices. I paid $40.00 for the one I purchased, a Hy-Gain 670B (Hy-range I). The radio that I bought lends itself very handily to conversion to the 10 meter ham band. The Hy-range I is a 23 channel, synthesized, 4 Watt output, AM radio. If you choose another type radio make sure you get one that uses crystals, not phase locked loop. The newer types with the synthesizer lend themselves to conversion better than the older types that use one crystal for transmit and one for receive. With the newer units you get a lot more useable channels for a lot less cost.

Looking at the schematic that came with the radio, I located the bandswitch and the oscillator crystals were next to it. The Hy-Gain schematic has a chart that shows the crystals required to synthesize the unit. What you want to do is to change the smallest number of crystals possible due to the cost factor. I decided to use the 4 crystals in the 14 MHz oscillator section and leave the 23 MHz section alone as it contains 6 crystals. It may be possible to change only the offset oscillator crystals, in this case, 11.275 and 11.730 MHz. I did not try this as I believed that the coils in the front end of the receiver and in the transmitter would probably tune the proper range without modification. This proved correct. The i-f section may or may not tune. I'll leave that to someone else to try together with the chance of blowing the price of a couple of crystals.

Channel	11 Meters	10 Meters	23 MHz	Old 14 MHz	New 17 MHz
1	26.965	29.000	23.290	14.950	17.440
2	26.975	29.010	23.290	14.960	17.450
3	26.985	29.020	23.290	14.970	17.460
4	27.005	29.040	23.290	14.990	17.480
5	27.015	29.050	23.340	14.950	17.440
6	27.025	29.060	23.340	14.960	17.450
7	27.035	29.070	23.340	14.970	17.460
8	27.055	29.090	23.340	14.990	17.480
9	27.065	29.100	23.390	14.950	17.440
10	27.075	29.110	23.390	14.960	17.450
11	27.085	29.120	23.390	14.970	17.460
12	27.105	29.140	23.390	14.990	17.480
13	27.115	29.150	23.440	14.950	17.440
14	27.125	29.160	23.440	14.960	17.450
15	27.135	29.170	23.440	14.970	17.460
16	27.155	29.190	23.440	14.990	17.480
17	27.165	29.200	23.490	14.950	17.440
18	27.175	29.210	23.490	14.960	17.450
19	27.185	29.220	23.490	14.970	17.460
20	27.205	29.240	23.490	14.990	17.480
21	27.215	29.250	23.540	14.950	17.440
22	27.225	29.260	23.540	14.960	17.450
23	27.255	29.290	23.540	14.990	17.480

Fig. 1.

The crystal needed for the Hy-Gain is determined as follows: Channel 1 is to be 29.000 MHz. The 23 MHz oscillator frequency is subtracted from 29.000 MHz. Then the offset oscillator frequency of 11.730 MHz is added to that figure giving the required frequency, in this case 17.440 MHz.

With one crystal then, I set my radio up on 6 channels which came out this way:

Channel 1 . . . 29.000 MHz
Channel 5 . . . 29.050 MHz
Channel 9 . . . 29.100 MHz
Channel 13 . . . 29.150 MHz
Channel 18 . . . 29.210 MHz
Channel 22 . . . 29.260 MHz

I felt that 6 channels were enough to start off with. The other channels will no longer transmit after the coils have been retuned, thus any possibility of transmission of unwanted frequencies will be avoided in case the channel selector happens to get off on a channel that is not set up on 10 meters.

In order to make it simple to keep track of what frequencies are combining to form the desired frequencies, I made up a chart giving all of the frequencies involved.

When you order a crystal, be sure and give all the information on your radio along with the frequency wanted. The Hy-Gain takes a 4342743 CS 26C 47 pF (International Crystal Co.).

Conversion

After taking the covers off, locate the 14 MHz oscillator section. This is the 4 crystals grouped together with their designation printed on the chassis. Locate X7 (14.950 MHz) and unsolder. Replace it with the 17.440 MHz crystal. Tune L2 and L3 down two full turns. Also tune L4 and L5 down two full turns. By now you should be seeing some output on a wattmeter or use the meter on the front of the radio. Tune the pre-drivers, driver and rf power amplifier for maximum output, in my case I easily got 6 Watts. It is important to tune L2 and L3, L4 and L5 in or down in the coil so that the synthesizer will end up with the sum (40.730 MHz) rather than the difference as I did at first.

For the receiver section, the coils to be tuned down two turns are L10 and L11. L12, L13, and L14 go only about one turn down. Using an external signal source on 29.000 MHz, apply a signal until the S-meter gives an indication, then peak the coils for maximum. The final sensitivity was as good as the manufacturer's specifications on the 27 MHz band.

The possibilities are numerous that these converted units can be put to. Inexpensive walkie-talkies can be converted. How about hidden transmitter hunts? CB antennas can be easily converted by reducing the length a couple of inches. The radio only draws about 100 mils when in a squelched condition, so it could be left on in order to catch band openings or local calls. So how about it fellows? Let's use all that space on 10 meters! Will be monitoring Channel 1 . . . (29.000 MHz) . . . see you on 10! ■

Harry J. Miller
991 42nd St.
Sarasota FL 33580

World's Smallest Continuity Tester

-- it's almost minute

Using a rubber-type two-pronged plug, the few components that make up this tester are mounted inside the plug. The hole in the end of the plug through which the cord enters is used for the NE-2 neon bulb.

Two small holes opposite each other are made near the base of the plug for the probe wires to extend, and the two 100k, ½ Watt resistors within the plug cavity, being in series with the probe cords, prevent shock. A piece of 5/8 inch i.d. aluminum tubing ½ inch long, placed over the bulb end of the plug, with a 5/8 inch o.d. clear plastic lens pressed into the tube, protects the bulb and enhances the appearance of the miniscule tester. Make the probe wires long enough to suit your needs. ■

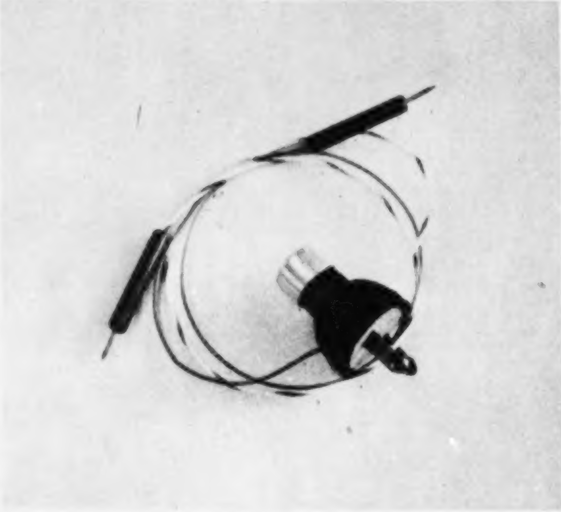

Fig. 1.

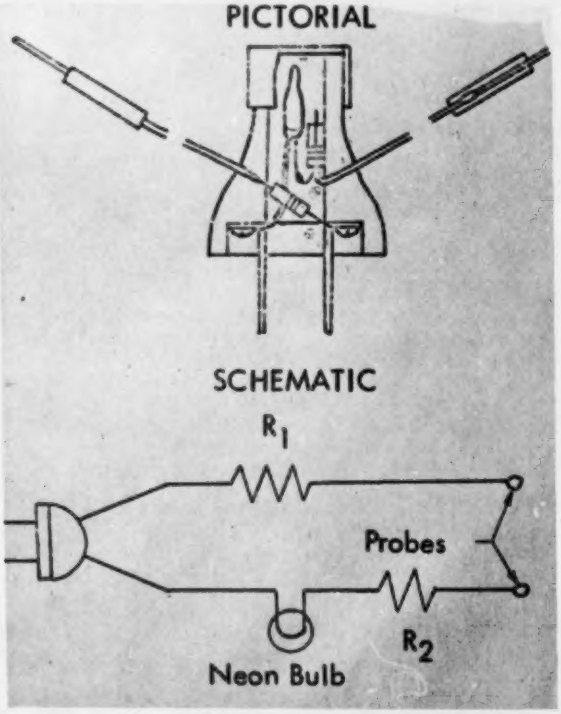

Fig. 2.

New Products

from page 38

VHF ENGINEERING PROFILE

Most hams into VHF experimenting are familiar with VHF Engineering products. The ubiquitous "RX" and "TX" receiver/transmitter strips have probably been responsible for getting more amateurs on VHF FM than any other series of products. VHF Engineering is an amateur success story.

The company was founded in a basement by Robert Brown W2EDN early in 1972. Brown's philosophy was based upon mass buying of components: Why not provide an inexpensive kit whose parts individually purchased would otherwise be overly expensive? The idea worked, and the small company soon expanded. To date, over 10,000 TX transmitter kits have been sold. An original product line of three devices has expanded to over 130.

VHF Engineering is now located on Water Street in Binghamton NY, the former site of McIntosh Labs, a manufacturer of quality high-fidelity gear. Most of VHF's business is amateur-related (about 70%), although the company also has military and civil contracts. Brown and Marv Druskoff K2VIV have designed most of the company's products. All of the pre-built VHF products are hand soldered and tested, as the company is not involved in high volume production. The company is actually a subsidiary of Brownian Electronics Corp., which is owned by Brown and William Kupfrian. They are presently projecting sales of over $1 million in the near future.

A look at VHF's product line will provide an insight into Brownian's success. The popular receiver and transmitter strips are multi-purpose devices that are the basis for many other products. The TX and RX strips are available for all VHF bands, and are also used in the company's hand-held transceivers and repeaters. Those repeaters are another story! VHF Engineering can provide complete repeater installations or any part of one, based upon customer requirements. Each module is available as a kit or pre-assembled, allowing complete flexibility in designing individual stations. The experience gained in repeater design has been valuable, as Brownian plans upon entering the two-way commercial marketplace in the future.

The product line also contains a wide range of power supplies and VHF/UHF power amplifiers, along with the most recent addition, a digital frequency synthesizer. The "building-block" concept allows the ham to select whate.er components fit his operating environment, all the way from power supply to final amplifier. VHF's latest line of power amplifiers is the Blue Line series, which are designed for high power UHF applications. Of course, the amplifier can be driven by a VHF Engineering TX strip! VHF also provides a complete line of accessories such as crystal decks, tone encoders, and cables.

Many hams would probably not be on the VHF bands had it not been for Brown's basement operation. The company is constantly expanding, and only time will tell what new devices from Binghamton will arise to excite today's VHF/UHF amateur.

John Molnar WA3ETD
Executive Editor

NEW WIRE DISPENSER ALSO CUTS AND STRIPS

The new WD series wire dispenser features unique cutting and stripping capability. Wire is drawn out of dispenser to the required length. Then, a built-in plunger cuts the length free from the roll, while a gentle pull through the stripping blade removes the insulation without nicking the wire. Repeating procedure removes insulation from second end. Although designed particularly for wire-wrapping, the inexpensive dispenser is ideal for many applications. The dispenser includes a 50 ft. (15m) roll of AWG 30 (0.25mm), top industrial quality, Kynar™-insulated, OFHC silver-plated solid copper wire. Insulation is offered in blue, white, yellow or red. Available from your local electronics distributor or directly from *OK Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475.*

NEW CATALOG COVERS LIGHT EMITTING DIODE (LED) DISPLAYS

National Semiconductor has prepared a full-color short form catalog detailing its complete line of optoelectronic products. The catalog contains photographs, outline drawings, and specifications of National's red, yellow, and green light emitting diode (LED) lamps, large area (0.3", 0.5" and 0.7" high) multi-digit numeric displays, small calculator-type numeric arrays, and watch display die. *National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara CA 95051.*

NEW CONTINENTAL SPECIALTIES CATALOG

Continental Specialties Corporation, manufacturers of breadboarding and test equipment for the professional and hobbyist, announces the release of their new 1977 catalog. This 16-page catalog features the complete line of Continental Specialties QT sockets, proto-clips, protoboards, logic probes, logic monitors and design mates, and introduces the new Experimentor sockets.

Catalogs are available from —*Continental Specialties Corporation, 44 Kendall Street, PO Box 1942, New Haven CT 06509.*

Marv Druskoff K2VIV.

Bob Brown W2EDN.

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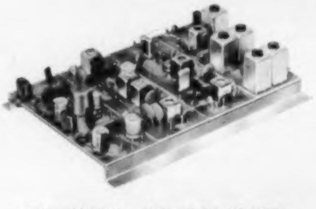
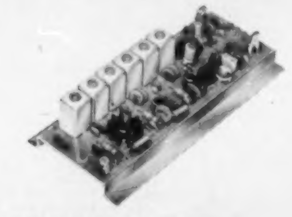
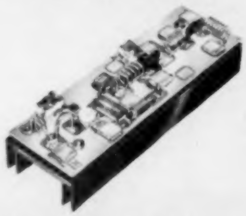
Vhf engineering offers a complete line of six meter FM kits and equipment.



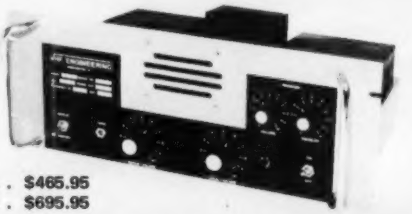
The RX50 is a NBFM 30-60 MHz Receiver Kit. Sensitivity is .3uV for 20 db squelch threshold .2uV Audio output, 2 watts.
Kit $59.95



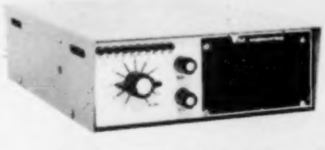
TX50 1 watt true fm 6 meter transmitter
Kit $39.95



PA50/25 6 meter power amp 1 watt in, 25 watt out
Kit $49.95



THE RPT50 SIX METER NBFM REPEATER
Kit $465.95
wired & tested . . $695.95



TRX50 complete 6 meter transceiver kit. 25 watt out, 10 channel scan. (Less mike and crystals.)
Kit $229.95

THE NEW RPT 50 IS A COMPLETELY SELF-CONTAINED ALL SOLID STATE REPEATER. It is conservatively rated, and built of high quality components. Much care and attention to make this repeater versatile as well as reliable.

The Model RPT 50 is supplied as complete repeater system. The receiver, transmitter, control circuitry, C.W. Identifier & 115/230 Volt AC power supply are all contained on a standard relay-rack panel and chassis unit. For most installations a user supplies AC power and suitable antennas with 50 OHM coaxial feed (PL 259 fittings). External connections for autopatch, tone control, etc. are provided. Built-in identifier programmed with up to 159 bits. Automatic emergency battery power changeover capability.

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Left to right – FT-620B, 6 Meter Transceiver • YP-150, Dummy Load Wattmeter • YO-100, Monitor Scope • FTV-250, 2 Meter Transverter • FTV-650, 6 Meter Transverter • FV-101B, External VFO • FT-101E 160-10 M Transceiver

Left to right – YC-601, Digital Frequency Display • YC-355D, Frequency Counter • FP-301, AC Power Supply • FT-301S Digital, All Solid State Transceiver • FV-301, External VFO • FT-221, 144-148 All Solid State All Mode Transceiver

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TR-7400A $399.00

2M MOBILE TRANSCEIVER. Synthesized PLL. Selectable output, 25 watts or 10 watts. 6 Digit LED freq. display. 144-148 MHz, 800 CH. in 5 KHz steps. 600 KHz repeater offset. Continuous tone-coded squelch (CTSC). Tone Burst.

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SSB TRANSCEIVER. PLL RF Monitor Noise Blanker. Digital hold locks counter & display at any frequency, but allows VFO to tune normally. True RF compressor adjustable speech processor. IF shift control. RF attenuator. VOX, GAIN, ANTIVOX and VOX delay controls. RF negative feedback. Optional digital readout. DRS Dial. High stability FET VFO.

TS-520 $629.00

SSB TRANSCEIVER. Proven in the shacks of thousands of discriminating hams, field day sites, DX and contest stations and mobile installations. Superb engineering and styling.

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TV-502 $249.00

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DYNAMIC MICROPHONE. Designed especially for homes. PTT and lock switches. 600 or 50K ohm.

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2M MOBILE/BASE FM TRANSCEIVER. Ignition interference control. 2 pole Xtal filter in IF rcvr. Protection for final stage transistor & reverse polarity connections. Priority Ch. switch. Quick release mount. LED CH. indicators. Switchable 10W or 1W output.

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COMMUNICATIONS RECEIVER. 1.8 to 29.7 MHz, WWV and CB band. 50 MHz, 144 MHz converter optional. Stable VFO & oscillator for 5 fixed channels. 1 KHz dial readout. Xtal filters (SSB/8 pole, CW/8 pole, AM/6 pole). Squelch. S meter. Noise blanker.

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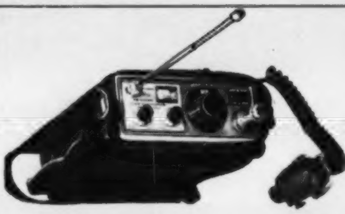
SSB TRANSMITTER. 3.5 to 29.7 MHz. Stable VFO. 1 KHz dial readout. 8 pole Xtal filter. AM Xmission available. Built-in AC pwr supply. Split frequency control available.

VFO-820 $145.00

Designed exclusively for use with TS-820. RIT circuit and control switch. Fully compatible with optional digital display.

VFO-520 (Not Shown) $116.00

Solid State Remote VFO. RIT circuit with LED indicator.



TR-2200A $229.00

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TR-33C	2M, FM, 12 CH. Portable	$229.95
MMK-33	Mobile/Dash/Desk Mount for TR-33C	$12.95
34PNB	Plug-In Noise Blanker for TR-4 Series	$100.00
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WV-4	RF Wattmeter, 20 to 200 MHz	$84.00
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7075	Desk Top Microphone	$39.00
1525EM	Pushbutton Encoding Microphone	$49.95
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TV-300-HP	300 ohm High Pass TV Set Filter	$10.60
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TV-42-LP	Transmitter Low Pass Filter. 100W	$14.60
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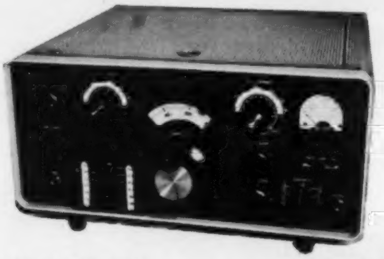

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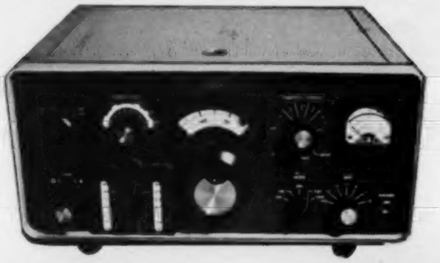
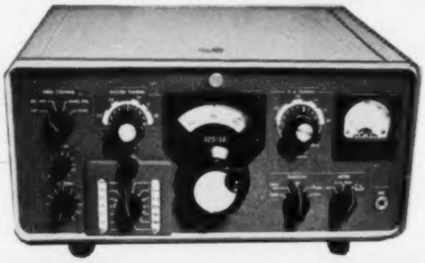
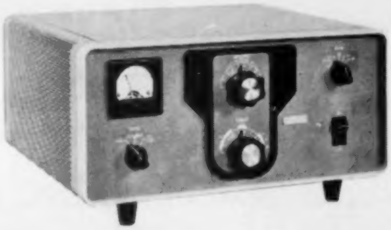


75S-3C RECEIVER **$2504.00**
Sharp selectivity. SSB, CW and RTTY. Single control rejection tuning. Variable BFO. Optional mechanical filters for CW, RTTY and AM. 2.1 KHz mechanical filter. Zener regulated oscillators. 3-position AGC.



32S-3A TRANSMITTER **$2597.00**
Covers all ham bands between 3.4 MHz and 30 MHz. Nominal output of 100W. 175W, SSB and 160W CW. Dual conversion. Automatic load control. RF inverse feedback. CW spotting control. Collins mechanical filter.



30L-1 LINEAR AMPLIFIER **$1536.00**
1000 watts PEP on SSB and 1000 Average on CW. Single control rejection tuning (50 dB). Variable BFO. 2.1 kHz Mechanical filter. Zener regulated oscillators. 3 position AGC. Exclusive comparator circuit.

312B-3 SPEAKER
$80.00

312B-4
SPEAKER CONSOLE
$546.00

312B-5 VFO CONSOLE
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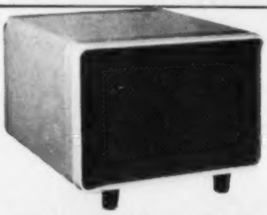

516F-2 AC POWER SUPPLY
$440.00

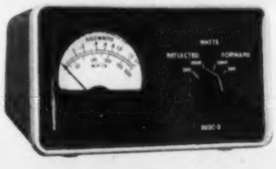

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Table 1
STANDARD ELEMENTS

Power Range	Frequency Bands (MHz) 2-30	25-60	50-125	100-250	200-500	400-1000
5 watts	—	5A	5B	5C	5D	5E
10 watts	—	10A	10B	10C	10D	10E
25 watts	—	25A	25B	25C	25D	25E
50 watts	50H	50A	50B	50C	50D	50E
100 watts	100H	100A	100B	100C	100D	100E
250 watts	250H	250A	250B	250C	250D	250E
500 watts	500H	500A	500B	500C	500D	500E
1000 watts	1000H	1000A	1000B	1000C	1000D	1000E
2500 watts	2500H					
5000 watts	5000H					

Table 2
LOW-POWER ELEMENTS

1 watt	Cat. No.	2.5 watts	Cat. No.
60-80 MHz	060-1	60-80 MHz	060-2
80-95 MHz	080-1	80-95 MHz	080-2
95-125 MHz	095-1	95-150 MHz	095-2
110-160 MHz	110-1	150-250 MHz	150-2
150-250 MHz	150-1	200-300 MHz	200-2
200-300 MHz	200-1	250-450 MHz	250-2
275-450 MHz	275-1	400-850 MHz	400-2
425-850 MHz	425-1	800-950 MHz	800-2
800-950 MHz	800-1		

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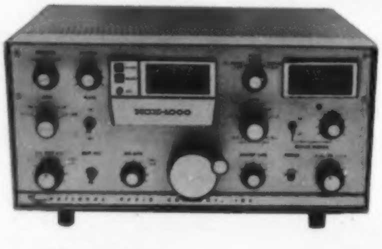

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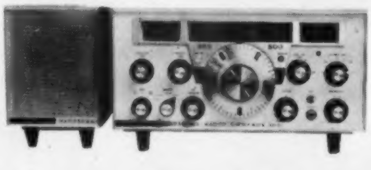

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The ultimate short wave receiver. This synthesized (phase lock loop) receiver incorporates all facilities for AM, Single Side Band (SSB), and CW receiption in all frequencies from the bottom of the very low frequency band (VLF) to the top of the high frequency band (HF). National's "dead accurate" dial means no searching for transmissions. Dial up the frequency and it's there: aeronautical, marine, CB, amateur, military, etc. Continuous coverage.

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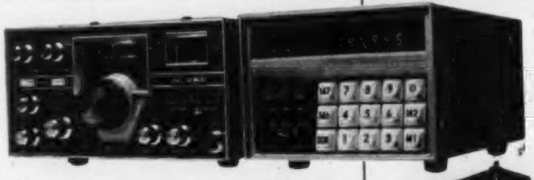

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ON
OFF
1 kHz
.1 kHz
14250
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FS-1	Pocket Field Strength Meter	10.95
WM1500	In-Line Wattmeter. 4 Scales to 1500W. 2 to 50 MHz	74.95
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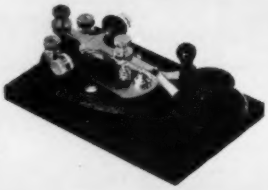
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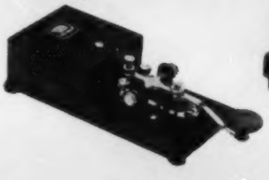
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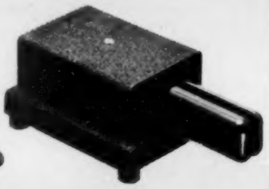
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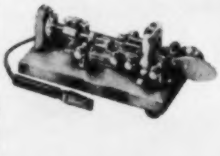
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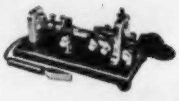
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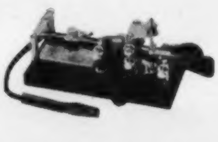
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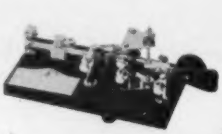
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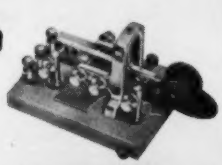
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The Super Amp runs a full 2000 watts P.E.P. input on SSB, and 1000 watts DC on CW; RTTY or SSTV 160-10 meters, the maximum legal power.

The Super Amp is compact, low profile, has a solid one-piece cabinet assuring maximum TVI shielding.

The heart of our amplifier, the power supply, is a continuous duty, self-contained supply built for contest performance.

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The hams at DenTron pride themselves on quality work, and we fight to keep prices down. That's why the dynamic DenTron Linear Amplifier beats them all at $499.50.

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SKYMASTER

A fully developed and tested 27 foot vertical antenna covers entire 10, 15, 20, and 40 meter bands using only one cleverly applied wave trap. A full 1/4 wave antenna on 20 meters. Constructed of heavy seamless aluminum with a factory tuned and tested HQ Trap, SKYMASTER is weatherproof and withstands winds up to 80 mph. Handles 2 KW power level and is for ground, roof or tower mounting. Radials included in our low price of

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Also 80 m resonator for top mounting on SKYMASTER.

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The antenna your neighbors will love. The new DenTron Trim-Tenna with 20 meter beam is designed for the discriminating amateur who wants fantastic performance in an environmentally appealing beam. It's really loaded! Up front there's a 13 foot 6 inch director with precision Hy-Q coils. And, 7 feet behind is a 16 foot driven element fed directly with 52 ohm coax. The Trim-Tenna mounts easily and what a difference in on-the-air performance between the Trim-Tenna and that dipole, long wire or inverted Vee you've been using. 4 & 6 Forward Gain Over Dipole.

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ALL BAND DOUBLET

This All Band Doublet or Inverted Type Antenna covers 160 thru 10 meters. Has total length of 130 feet (14 ga. stranded copper) although it may be made shorter if necessary. This tuned Doublet is center fed through 100 feet of 450 ohm PVC covered balanced transmission line. The assembly is complete. Add rope to the ends and pull up into position. Tune with the DenTron Super Tuner and you're on 10 through 160 meters with one antenna! Now just for the DenTron All Band Doublet.

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DenTron ANTENNA TUNER

The 80-10 Skymatcher

Here's an antenna tuner for 80 through 10 meters, handles 500 w P.E.P. and matches your 52 ohm transceiver to a random wire antenna.

- Continuous tuning 3.2 - 30 mc
- "L" network
- Ceramic 12 position rotary switch
- SO—239 receptional to transmitter
- Random wire tuner
- 3000 volt capacitor spacing
- Tapped inductor
- Ceramic antenna feed thru
- 7" W. 5" H. 8" D., Weight: 5 lbs.

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Read forward and reflected watts at the same time

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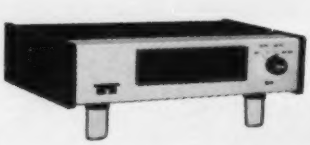

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MODEL 509 $329.00
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MODEL 405 $159.00
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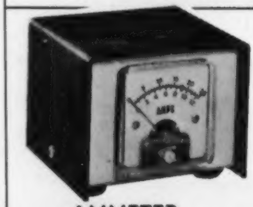

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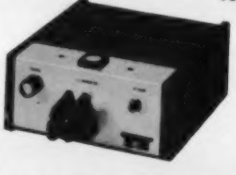

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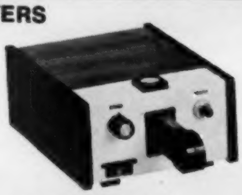

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Open New Frontiers!

-- VHF sideband

I heard some "lowbanders" (HF types) chatting away the other day about some "crazy VHFer in Santa Cruz" (not me, by the way) who claimed to work Los Angeles, Fresno, and the like . . . even some mobiles out to about 150 miles on *two meters*!

The other fellow said, "Ah, sure. It's them repeaters, you know."

"Nope," replied the first. "This guy was using one of those little three Watt rice box rigs on *sideband direct* . . . not on any repeater, so he *says*!"

"Oh," replied number two. "Well, everyone knows those VHF SSB types are liars!"

Where's the Fun Gone?

I'm not so old and I haven't been in ham radio for much more than a dozen years, but it seems that some of the fun has gone out of the hobby for many people. Maybe it's because of the loss of so much of the "new blood" to CB, leaving us devoid of the enthusiasm generated by newcomers to the hobby. Maybe it's because of the rich man's war that has made 20 and 40 meter beams and kilowatts *required* equipment nowadays rather than luxuries. Maybe it's because unless you really dig CW (which can be operated with a minimum of cash outlay) or really like to stand in line on the local repeater for 25 minutes in order to get your *very own* three minutes (down to one minute on some machines around here), then you're either going to have to lay out a few kilobucks for gear or buy some ancient metal monster that's *already* been used for a boat anchor. The latter is not any more likely to make "brownie points" with the wife than the former!

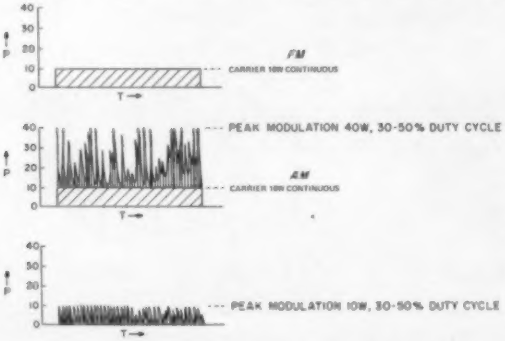

Fig. 1. Average power.

Frankly, when I got back on two meters after a few years' absence due to higher education, I wasn't enthralled by what I heard. True, to each his own, but I couldn't quite relate to tone bursts and 25 minute waiting lines on the local repeaters. I also balked at the four page lists of "dos" and "don'ts" that were being handed out by some repeater groups. Of course, the $20 initiation fee and $10 yearly assessment was a bit beyond my meager student income, too. So I stuck to the small but still active group of AMers left on the band.

Unfortunately, when I moved from the Bay Area to Santa Cruz, the 3000 foot mountains put a real dent in my signal. Though I could hear the boys across the hills on my receiver/converter combination, they had trouble picking me out of the noise on their Communicators and the like. If only those two meter AM rigs modulated like CB sets, had noise limiters, and good sensitivity!

At the time, two meter SSB was a once-a-week, Tuesday night net thing with about 15 active stations. However, I found a two meter single sideband transceiver (so it said on the label) made by Belcom so I put the thing on the air and made some noise! Having worked all the then-active SF Bay Area stations and finding the rig a nice package, I took it up to the SRI VHF/UHF Society meeting to a show-and-tell session and showed it off. Bruce Clark K6JYO scanned it with interest and shot off for home shortly after the meeting so that he could work me mobile all the way home to Santa Cruz . . . some 45 miles through those 3000 foot mountains. After this successful test, Bruce got KLM interested in the unit and the rest is history!

Why Single Sideband?

This isn't a question that's asked on the HF bands much any more, where sideband's advantages in a crowded band and for DX are obvious. On VHF there are fewer people who have been exposed to its advantages.

Single sideband has the same advantages on VHF that it has on the HF bands. It requires low average power drain for a given effective power, extends PA life and reduces heat sink requirements due to lower *average* power dissipation, reduces multipath and phase distortion, increases potential sensitivity by reducing required bandwidth, allows break-in operation, and provides excellent weak signal recovery.

These last two features have been responsible for the increase in medium range "DX" contacts on two meters in recent years. With increased activity, weak signals are often heard between syllables during a local QSO (something not possible with FM), and though the signal may not be copyable, with SSB *something* can be heard

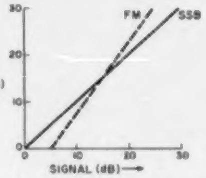

Fig. 2. Weak signal effectiveness. FM s/n is better than SSB above *10 dB s/n, but SSB is superior on weak signals below 10 dB s/n. This makes SSB better able to find and copy weak DX stations.*

and beams be brought around to peak up the station – or the old VHF wait-for-the peak game can begin.

Sideband Working Distance

In everyday terms, sideband extends the radio horizon 50% to 100%. In hilly terrain where multipath is a problem, sideband's advantage over FM can be even greater than 100%!

Here in hilly California, repeaters have a typical working range of 50-150 miles radius. Ten Watt sideband stations typically run equal range *and better* with higher powered stations (50-150 W), getting frequent contacts out to three or four hundred miles.

It is not uncommon, for example, for Santa Clara Valley stations running 10-20 W to work into Los Angeles on a good night. Well located, high powered stations like Mike Stahl of KLM or Jay Shaffer W6BWB can work LA and San Diego almost any time of day or night!

Special Modes

In addition to regular point-to-point communication, there *is* one repeater on two meters (though sidebanders prefer the term "translator") that is used quite extensively throughout the United States. It has a beautiful location about 1000 *miles* above sea level and has a working radius of some *2500 miles*! Oscar VI and more recently Oscar VII provide a fascinating means of SSB and CW contacts for anyone with a Technician class license or higher.

From the East Coast, Britain and Western Europe can be worked via Oscar. Canada and Mexico, Central and parts of South America can be worked throughout the U.S. Japan and the Pacific are available to West Coast hams.

Getting Started

There are several approaches to VHF SSB. The easiest for the HF operator with a rig having a low power transverter output is to buy the transverter made for his rig.

Those who prefer not to tie up their HF rig when they get on VHF SSB may prefer one of the separate transceivers available.

Those who already operate two meter FM may want to trade up to one of the AM/FM/SSB/CW multimode rigs now available.

The following listing gives a brief overview of what's available, including some general remarks about the strengths and weaknesses of each rig.

THE KLM ECHO II

The KLM Echo II was the first two meter transceiver available (discounting the Gonset Sidewinder from several years back). It is totally solid state and runs off 11-15 V dc (no built-in ac supply). It is conveniently mobile, measuring only 2.5 x 8.5 x 10 inches, and has squelch (the only unit that does on SSB), an effective noise blanker, and excellent stability (crystal control with a VXO and RIT).

Specifications

Sensitivity: under .18 uV typical*;
Selectivity: 2.1 kHz @ 6 dB, 4.2 kHz @ 50 dB typical*;
Af Output: 3 W into 4 Ohms @ 10% THD;
Rf Output: 10 W PEP typical @ -22 dB 3rd order distortion*;
Spurious: -55 dB typical*;
Harmonics: -60 dB typical*;
Af Response: 150-2250 Hz* typical*;
Features: S/RFO meter, Crystalplexed synthesizer with VXO (±6 kHz) and RIT (±2.5 kHz receive only), squelch, noise blanker, ALC, vswr protection, semi break-in CW, bandswitch (up to 5 bands, 230 kHz each with 145-145.23 and 145.77-146 included), ext. key for linear, ext. spkr. jack, upper and lower sideband mod kit (for Oscar VII downlink), and accessory FET preamp (improves AGC action and gives .08 uV/12 dB SINAD or better);
Price: $390.

Pluses and Minuses

On the plus side, the Echo II is easy to service, has plenty of room available for modifications, and costs less than the multi-mode rigs. The only other SSB-only rig is only 3 W PEP and isn't easily modified for lower sideband for Oscar reception. The VXO allows good frequency control and resettability, so that finding frequencies for skeds is easy. Given two Echo IIs, if each moves up 30 kHz (three channels) they will end up within 100 Hz of each other. This is great for mobile where QSYing can be safely done by merely counting one channel for each 10 kHz *without looking* at the dial.

The major drawback with the receiver is the lack of AGC below 1 uV. This is quite bothersome when working strong locals with weak DX. The KLM preamp helps with this, as do other mods.

The transmitter is frequently accused of being "muffled" or "bassy." This can be helped by tuning the BFO frequency until a 400 Hz tone in the mike input drops to ½ W from a starting level of 2 W (6 dB). Of course, this drops the CW output quite a bit as well. Another approach is to find a mike with a natural roll-off below 1 kHz. (Note: A D-104 *doesn't* work unless its high output is transformer-coupled to the 500 Ohm Echo II input.)

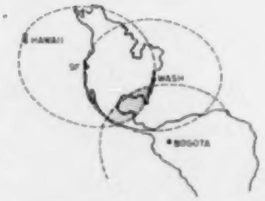

Fig. 3. Oscar working radios. Overlapping areas can work each other.

THE ICOM IC-202

The Icom IC-202 is SSB only. It is a "walkie-talkie" similiar in size to the TR-22 FM rig. About 2.5 x 6.5 x 7.5 inches, it has a built-in whip antenna in addition to its normal output jack. The unit covers 200 kHz with a VXO multiplied up from 14 MHz and calibrated in 5 kHz increments. There are positions for four crystals, with 144.0 and 144.2 MHz standard. Why Icom doesn't make 145 MHz one of the standard crystals, I have no idea, considering that it would about *double* their potential customers by adding the Technicians.

The receiver works quite well with a MOSFET/JFET front end which gives 70 dB intermod and crossmod rejection. AGC is reasonable . . . about 15 dB change from .3 uV to 1000 uV input change. Provision is made for an external VFO, although none is presently available.

Specifications

Sensitivity: under .125uV typical*;
Selectivity: 2.4 kHz/4.8 kHz (6 dB/60 dB), 70 dB ultimate;
Af Output: 1.0 Watt @ 10 THD into 4 Ohms*;
Rf Output: 3.2 W PEP typical @ -30 dB 3rd order distortion*;
Spurious: -60 dB or better (most below 70 dB*);
Harmonics: -60 dB or better;

***Values marked with an asterisk are units that I have tested or had dealings with. Sensitivity = 12 dB SINAD. Tx IMD referenced to *each* tone. Spurs and harmonics references to PEP output.**

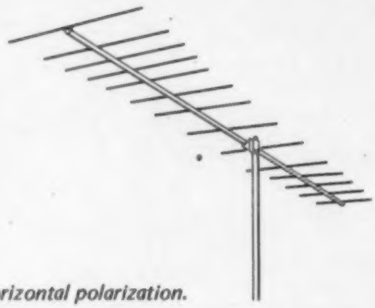

Fig. 4. Horizontal polarization.

Af Response: 500-2900 Hz typical*;
Features: S/RFO meter, 200 kHz VXO calibrated in 5 kHz steps, noise blanker, ALC, RIT with center off detent, CW/SSB switch, bandswitch (four bands, 144.0, 144.2 included), external speaker jack, VFO input jack, built-in battery compartment (uses nine "C" cells), carrying strap, pilot light/panel light on/off switch (to conserve power on batteries), built-in whip antenna;
Price: $280.

The Good, the Bad, and . . .

The IC-202 comes with a very good, large size schematic in spite of the 202's small size. It is extremely portable and fun to take on trips or mountaintopping. Numerous 202s have shown up on the air in the Monterey Bay Area and San Francisco Bay Area while their owners were on vacation or on business in the area. It also is a natural for emergency and public service operation. The unit's range varies depending on terrain and location, but normally has good signals over 5-10 miles with marginal results as far as 25-30 miles. Mountaintoppers can expect 100 miles easy with the built-in whip — and more with a beam.

The 202's receiver is remarkably free from spurious, crossmod, and intermodulation problems. Under some conditions, the noise blanker will cause cross modulation by very strong in-band stations. Most of the time it does not, though. Its sensitivity is about what is needed for a 3 Watt rig, but can be improved. I suggest using a preamp of the FET type (*not* MOSFET), with about 10-15 dB gain mounted in the power amplifier box if one is added later. The J-310 or U-310 (Siliconix) are popular on the West Coast for this.

All 202s have a slight drift problem, especially if cheaper US crystals are used in the VXO. Some retuning in any ten minute period is often required, but it is by no means as bad as what we used to put up with on 2m AM several years back. Checks in the lab show about 500 Hz drift over a temperature range of -30 to +50 degrees Centigrade. Normal variations can then be expected to be 100-200 Hz at room temperature. (By the way, if your shack has the kind of temperature range we used in the lab, I suggest you install a heater in the place!)

The 1 Watt audio output is adequate for most applications. However, in noisier vehicles like my VW bus, the af output is marginal. A well placed external speaker would probably help.

The size of the IC-202 is both a blessing and a curse. Of course, it makes it very convenient for mobile operation, but it also makes it difficult to service or modify. This is why I suggest putting any preamps in the power amplifier instead of trying to put it inside. It also makes it difficult (probably impractical) to put lower sideband into the 202.

THE KENWOOD TV-502

The first transverter that became apparent on the market in the recent sideband boom was the Kenwood TV-502. It covers 144-146 in two bands, with the 144-145.7 range included normally (converting from 28.0-29.7 MHz). The transmitting section seems to be very clean sounding and puts out around 8 W PEP. The receiving converter lacks gain and noise figure, so that its sensitivity is only around .5 uV; an additional preamp is almost always necessary. There *is* room to build the preamp inside the unit. The 502 matches the Kenwood HF line, of course. Price class . . . $260.00.

YAESU

Yaesu also makes a transverter for their equipment, but none has shown up in this area as yet. Little information (specs, price, etc.) is given in the ads by Yaesu, but performance equivalent to the Kenwood seems likely, with a price to match. It seems that there is little effort on Yaesu's part to promote this unit, as they don't tell enough about it to get anyone interested in it!

THE EUROPA B

A different approach can be seen in the Europa B transverter ads. Through small ads by a small company, I can learn that the unit uses 5894s in the final with about 80 W PEP output, interfaces with the Yaesu line with no external power required, is 9 x 4-3/4 x 4-1/2 inches, has MOSFETs in the converter section, and requires about 100 mW of drive. It costs $299 ($279 without tubes).

THE KLM MULTI-2000

An early comer to two meter SSB was the ITC Multi-2000. Unfortunately, the small size of the importing company did not result in good enough quality control, and numbers of these multimode, synthesized rigs got out to the field with out-of-band spurs only 25-35 dB down! The FAA got upset, since these were falling on aviation frequencies, and the FCC "respectfully requested" some changes. Well, KLM was the change that came about. They bought out ITC's franchise for the Multi (made by FDK of Japan) and bought an HP Spectrum Analyzer so that *each unit* could be checked before going out. They also sent a test unit to the FCC, which gave it a clean bill of health. So now the Multi-2000 is one of the four multimode rigs on the market.

Specifications

Sensitivity: .1 uV typical (less if peaked for 1 MHz of the band)*;
Selectivity: 2.4 kHz;
Af Output: 2 Watts into 4 Ohms @ 10% THD;
Rf Output: around 10 W PEP;
Spurious: -55 to -60 dB or better;
Harmonics: -60 dB or better;
Af Response: 300-2700 Hz;
Features: S/RFO meter, digital synthesizer with 10 kHz steps across the entire 2m band, VXO (±10 kHz), RIT (±5 kHz), noise blanker, ALC, CW/AM/FM/SSB, upper and lower SSB, ext. key for linear, ext. spkr. jack, wideband and narrowband FM, 600 kHz up or down or simplex, three crystal channels, FM squelch, FM 1 W or 10 W position, rf gain control, ac and dc power supplies built in.

Strengths and Weaknesses

Unlike the other multimode rigs, the Multi-2000 features a PLL synthesized 10 kHz step frequency control, which makes frequency setting for FM (and SSB, for that matter) very easy. Each click is ten kHz, making mobile operation safer by not requiring the operator to tune by a meter or VFO, etc. Of course, there are times when the VFO is better, as when operating SSB. However, the VXO and RIT allow good flexibility here, too.

The Multi's AGC has had some problems according to some users. It's not as bad as the Echo II, but perhaps not quite as good as the FT-221 or TS-700. I get an impression from off-the-air comments that the difference is slight, however.

As previously mentioned, the early Multi's had out-of-band spurious problems with a vengeance. This has been cured by KLM's quality control.

Some feel that the Multi-2000's transmit audio is not quite as good as the other multimode units. While I agree that it usually does not sound as "hi-fi," I think that I have heard about as many FT-221s and TS-700s with bad audio as Multi's. A *good* 221 or 700 sounds very good, but a bad one sounds really bad.

THE KLM MULTI-2700

Another entry in the multimode market is the KLM Multi-2700. This rig has a stiff $800 price tag, but it has some unique features, too. These include a VFO *or* PLL 10 kHz per step synthesizer, converter built in to receive the 10m Oscar downlink with reception tracking the two meter transmitter, VOX, LED readout, and user programmable FM repeater splits in addition to the normal ±600 kHz splits.

Specifications

Sensitivity: .1 uV;
Selectivity: 2.4 kHz;
Af Output: 2 W into 4 Ohms @ 10% THD;
Rf Output: 10 W PEP (10 W or 1 W FM);
Spurious: -60 dB or better;
Harmonics: -60 dB or better;
Af Response: 400-2800 Hz;
Features: S/RFO meter, PLL 10 kHz step synthesizer *or* VFO, VXO, RIT, CW/FM/SSB, upper and lower SSB, noise blanker, ALC, ext. key for linear, ext. spkr. jack, FM squelch, built-in ac and dc supply (incl. 220 V European standard with 115 V ac and 14 V dc), space for 50 MHz or 432 MHz converters, LED readout, tracking converter for Oscar 10m downlink (but cannot receive while transmitting), 600 kHz up/down split or user programmed, built-in VOX.

As this unit is barely introduced as I write this, little is known of its performance. Listening to this unit, I noted that it is clean, but not "hi-fi." The Oscar feature is nice. One drawback is that the 10m downlink can't be monitored while transmitting, since the unit is a transceiver having a common i-f. The RIT can be used to approximate the Doppler shift, but this is imprecise, to put it mildly! It is still quite usable in this mode, even if not as convenient as a separate receiver.

THE YAESU FT-221

As soon as it hit the market, the FT-221 was a success. By preceding the TS-700 by a few weeks and by being more readily available in stock early in the game, the 221 has enjoyed a great deal more popularity in *this* area than the TS-700. One frequently mentioned reason is the modularized construction the rig sports. Cosmetic-wise, the two are essentially similar, but the 221 has its circuits on vertically-mounted cards, providing good isolation and ease of replacement. The theory goes that service is easier, too. If you happen to have a substitute board, I suppose this is true, but unless you have extender boards (not supplied), service of a "live" circuit is out of the question! So, it's six-of-one-and-half-a-dozen-of-the-other.

Specifications

Sensitivity: .2 uV or less on SSB;
Selectivity: 2.4 kHz/4.1 kHz 6/60 dB;
Af Output: 2 Watts into 4 Ohms @ 10% THD;
Rf Output: 12 W PEP nominal (14-16 W typical, 18 W on FM);
Spurious: -60 dB;
Harmonics: -60 dB;
Af Response: 300-2700 Hz;
Features: S/RFO/FM tuning meter, phase locked VFO covering all of two meters in 500 kHz bands, 1 kHz readout, AM (2 W), FM, CW, SSB, upper and lower SSB, noise blanker, ALC, ext. spkr. jack, FM squelch, ac and dc power supplies, tx/rx or rx only clarifier.

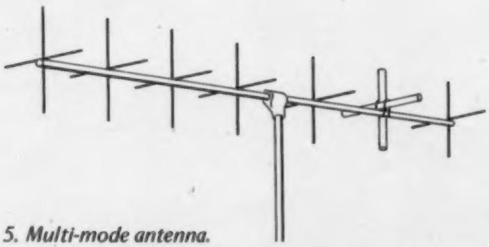

Fig. 5. Multi-mode antenna.

Bouquets and Brickbats

The only real problem that has been noted on the FT-221 is that the gain setting for FM and SSB on the mike gain control is not the same. With normal FM mike gains, SSB tends to overdo it a bit, causing distortion. Since this level is front panel controlled, no problem should exist once proper levels are established for the two modes.

Even with proper settings, some FT-221s have bassy and mushy audio. Most units are very clean and good sounding, but *some* have this problem.

Some 221s have lacked sensitivity. Most are good, but *some* seem to get through Yaesu's quality control department.

On the plus side, most 221 owners are quite happy with the units on both SSB and FM. Good ones sound *very good.*

THE KENWOOD TS-700A

Kenwood's TS-700A is similar in function and performance to the FT-221. It also features full coverage of two meters in 500 kHz segments (VFO) and has AM/FM/SSB/CW. Styling is also similar. One notable difference is that the 700 has final load and drive controls, making its operation less "hands-off" than the Multi-2000 or FT-221. I'm told by users that these controls are very broad, requiring little adjustment over a given band segment, however.

Specifications

Sensitivity: .1 uV/12 dB SINAD;
Selectivity: 2.4 kHz/4.8 kHz @ 6/60 dB;
Af Output: 2 Watts into 4 Ohms @ 10% THD;
Rf Output: 10 W PEP, 3 W AM;
Spurious: -60 dB;
Harmonics: -60 dB;
Af Response: 400-2600 Hz (published);
Features: S/RFO meter, FM tuning meter, PLL VFO in 500 kHz bands across 144-148 MHz, 1 kHz readout, AM/FM/SSB/CW, upper and lower SSB, noise blanker, ALC, ext. spkr. jack, FM squelch, built-in ac/dc power supply tx/rx or rx only clarifier;
Price: Around $700.

Ups and Downs

Most sound very good on the air, with a resonant "broadcast quality" tone. The tone is not necessarily "natural," however, and under weak signal conditions *some* voices do not "punch through" too well. Adjustment could be made by microphone choice or BFO frequency shift, if desired.

Most comments of TS-700 owners parallel those of FT-221 owners. The AGC in both cases is reasonable, but not as good as might be desired for working DX and locals simultaneously. A preamp could be useful, especially if a linear is added to the system (j-310, or equivalent).

Which Way To Go?

As you can see, the options for two meter side-

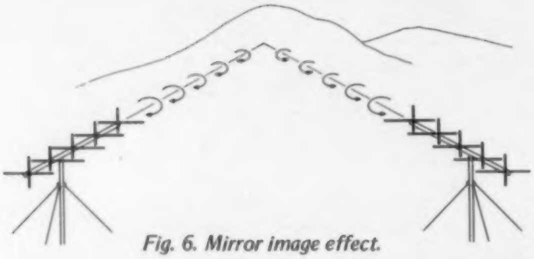

Fig. 6. Mirror image effect.

band have rapidly expanded in the past two years. Since KLM broke the waters with the Echo II, sideband has been growing very rapidly, with several manufacturers jumping on the bandwagon. Your final choice should be based on your operating habits and taste. But don't let your *current* operating habits have too much influence, as you may decide to *change them* once you've been on sideband for a while!

Of course, the best thing is to compare units side by side. Unfortunately, not all stores stock all units, and their open hours are often not during peak operating hours. So you may have to socialize a bit and find someone who has the unit(s) you are interested in and give him a visit. This is a good bet, anyway, since he can give you an idea of the idiosyncrasies of the rig, along with its good points. He can also give you pointers on other aspects of setting up a VHF SSB station.

As far as one method of getting on over another . . . transceiver or transverter, etc. . . . it depends on your budget and needs. If you don't mind tying up the HF rig while operating VHF SSB, a transverter is an inexpensive way to get on. Consider, however, that unless your HF rig has a noise blanker, the transverter method suffers 6-20 dB degradation in performance on reception when ignition or other noise exists. It can also be annoying!

If you have FM and just want to add SSB with little additional outlay, the IC-202 or Echo II would look good. This also allows simultaneous monitoring of SSB and FM (which could be a plus in emergencies).

Full coverage and all modes are the attractive features of the 2000, 2700, 221, and 700 multi-mode rigs. Trading up to these rigs buys not only SSB but full frequency FM coverage as well!

Other Things

Of course, a beam antenna, horizontally polarized, is likely to be something you'll want to add. Vertical beams or ground planes and the like are good for repeater use, but the cross polarization is going to cost you 10-30 dB when you try to work SSB stations (all of which are horizontal except for newcomers). There's good reason behind horizontal. This polarization has less sensitivity to noise than vertical, and seems to have better consistency over long-haul paths. In 1963, several Santa Cruz VHFers experimented with WB6IZF in King City . . . a path of about 100 miles. WA6YOG used an antenna rotatable in polarity from full vertical to full horizontal, as did IZF. Over a period of several months, horizontal showed better signal levels and less fading than vertical, and horizontal gave up to 6 dB improvement in noise rejection on the AM signals. Cross polarization showed 10-30 dB of loss, as would be expected.

As for what antenna to buy, your budget may be the limiting factor. Here in the West we are partial to the KLM line of antennas. Perhaps it's because Mike and Mel of KLM are quite active on 2m SSB out here, but it is also because their broadband, rugged antennas work exceptionally well. Many of the top moonbounce stations are using the KLM 12 or 14 element beams in their arrays, simply because they are made of heavy gauge aluminum. Since they cover the entire two meter band with low vswr and high gain, they are easy to stack without worrying about detuning one antenna with another close by.

On the other hand, the antennas made by CushCraft and Hy-Gain are also good, though made with lighter aluminum and narrower bandwidth (standard yagi) design. Their prices are very attractive compared to KLM's, being roughly one-half to two-thirds as much. *At resonance*, they can perform as well as the KLM units, but bandwidth will only be about one megacycle for 5 elements and around 500 kHz for long yagis. Stacking can be problematical beyond two antennas, as well.

One interesting consideration for owners of multimode rigs is the circularly polarized antennas that use only one feedline. These allow SSB and FM operation without switching antennas for vertical and horizontal polarization. KLM, CushCraft, and Hy-Gain all make them. KLM's cover all of two meters, but cannot have the polarity switched from left- to right-hand polarization. The others are normally cut with the vertical elements favoring 146-148 MHz and the horizontal elements favoring 144-146.

There is one caution to be noted here, though, and that is that two stations using circularly polarized antennas over a reflected path (bounced off a mountain, etc.) will end up cross polarized because of the "mirror image" effect. If one station is able to reverse his polarization (e.g., right-hand to left-hand), this problem can be eliminated. There is no such provision on the KLM antenna (KLM 16-C). The others show how it can be done, and since the elements are cut for opposite ends of the band, true CP doesn't really exist (it's more elliptical than circular).

Another caution is that CP causes a 3 dB drop in signal strength over the equivalent linearly polarized antenna, since half of the power goes to the vertical antenna and half to the horizontal. If working a horizontal station, he only receives the horizontal radiation. The same is true for vertical. Of course, when working another CP station, the 3 dB is *not* lost, and considering that 10-30 dB is lost by being *cross polarized* when using a vertical beam working a horizontally polarized station, the 3 dB loss is a good compromise!

So again, it boils down to your needs and choices. Five elements for SSB should be a minimum. Twelve or fourteen is typical. For Oscar satellite use, three or four elements, vertically polarized, tiled up from the horizon by about 30-40 degrees, work very well. Twenty-five to fifty foot antenna height is average, but higher antennas can give a decided advantage for stations shadowed by mountains close by. Figure about 6 dB every time you *double* the antenna height.

Be careful of cheap, CB-type coax. This stuff (sold by Radio Shack and others) has only partial shielding (recognizable by the loose weave of the shield) and is *not* good for two meters! It is lossy and may cause vswr problems.

Use a good grade Belden or Times Wire, RG-58 or RG-59, for runs up to 35-45 feet, total. Up to 100 foot runs, RG-8 or RG-11 is good. Above 100 feet, RG-17, though quite expensive, really pays off. Make sure the coax you use is the right impedance for your system. (58 and 8 are 50 Ohms, 59 and 11 are 75 Ohms.)

If you buy a cheaper antenna, make sure to trim it so that it is tuned for your operating frequency. If you do this, you'll get optimum results and you'll have saved some money. If you don't, you may not be as happy as you would have been if you did.

Worrywarts of America

If that three minute timer's got you fretting about getting cut off in mid-sentence and you don't mind someone making nasty remarks under your five minute monologue (which you can do on sideband and everyone but the guy with the mike button pushed will hear it), get on board two meter sideband! We may sound like a bunch of higher class CBers on those occasions when our mood is less than sober (we like to have fun), but I dare say that most of our joking around would go right over the heads of the eleven meter crowd. You'll get *few* comments about your operating procedures on SSB (unless you're one of those who likes to run 15 kHz wide FM on the sideband frequencies . . . we *do* get unblessed by *some* things!). Not only that, but occasional "drop in" DX makes the band quite interesting. And when the marginal fringe (say, 150-250 miles) starts coming in like it was local, extended rag chews with stations you normally say "hello"/goodbye" to make for a community spirit.

Who knows? Someday *I* may even join an FM repeater group, but for now I'm enjoying myself too much on the lower end of two meters! Hope to meet *you* there someday! ■

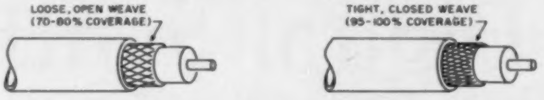

Fig. 7. Cheap coax: bad on left, good on right.

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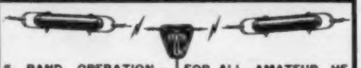

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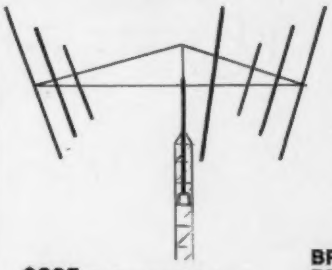

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Not that this unit can't be used with the transistor type rigs – it can! If the transmitter requires 6, 12, or 18 MHz crystals, read on.

Some basic parameters were desired for the unit for use around the ham shack here. They were:

1. The unit should be "program" type in common switch combination, not tons of diode matrixes, rotary switches, etc. The ideal would be a decimal type thumbwheel switch having BCD outputs.

2. It should not require "coding," that is, the number you dial in should be identical to the frequency desired. No tables or charts.

3. It should use only cheap and easily available ICs, preferably TTL digital. This is my own hard core feeling of digital over PLL, analog, etc.

4. For my own requirement, it should be remote capable using only a single rf type cable to the transmitter strip. Multi-wire cables are both a problem and also can be quite costly for a 30 to 40 foot run like I have. When the EME rack went into the basement ham shack, the FM 3 band base rack had to go – upstairs to the back porch.

5. Comparison of desired and running frequencies must be done before modulation to avoid after lockup hunting.

6. Frequency derivation should have both the other bands in mind, the use of the Motorola "strip" transmitters because of their easy availability and maintenance (it is commercial grade gear), and

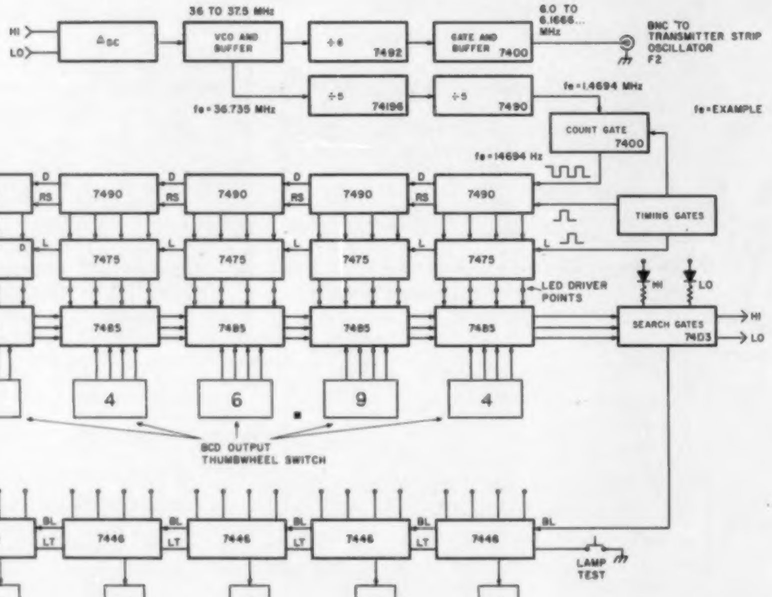
HI
LO
ΔDC
36 TO 37.5 MHz
VCO AND BUFFER
÷6 7492
GATE AND BUFFER 7400
6.0 TO 6.1666... MHz
BNC TO TRANSMITTER STRIP OSCILLATOR F2
fe = 36.735 MHz
÷5 74196
÷5 7490
fe = 1.4694 MHz
fe = EXAMPLE
COUNT GATE 7400
fe = 14694 Hz
7490
D
RS
A B C D
7475
L
TIMING GATES
LED DRIVER POINTS
7485
SEARCH GATES 7403
HI
LO
1
4
6
9
4
BCD OUTPUT THUMBWHEEL SWITCH
7446
BL
LT
LAMP TEST
DP

Fig. 1. Block diagram.

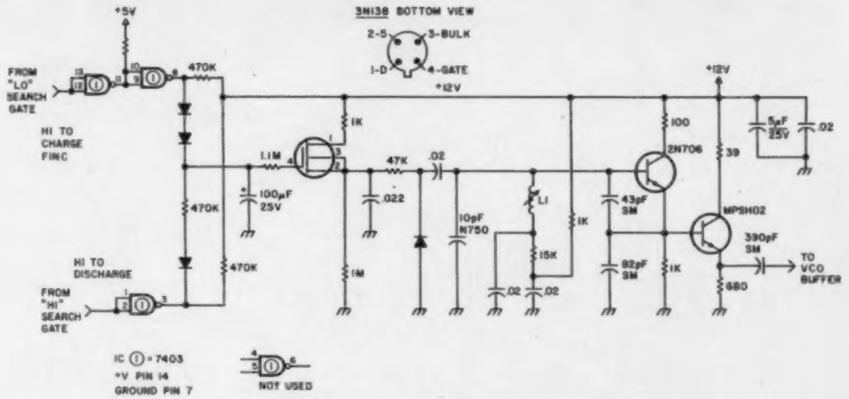
+5V
3N139 BOTTOM VIEW
2-S
3-BULK
1-D
4-GATE
+12V
FROM "LO" SEARCH GATE
470K
HI TO CHARGE FINC
L1M
1K
47K
.02
.022
100μF 25V
470K
10pF N750
L1
1K
15K
.02
.02
1M
HI TO DISCHARGE
470K
FROM "HI" SEARCH GATE
100
2N706
39
5μF 25V
.02
43pF SM
82pF SM
1K
MPSH02
390pF SM
TO VCO BUFFER
680
IC ①=7403
+V PIN 14
GROUND PIN 7
NOT USED

Fig. 2. VCO and "memory." L1=5½T #20 enam. ¼" form.

low cost now, and to do all this be of a divide nature (TTL) rather than multiplication type (discrete tuned circuits, bandwidth, etc.). The last requirement was going to be hard enough to do just getting the bandwidth out of the commercial strips – or so I thought.

I believe you will find it very beneficial to your success if you do things in a specific order on this project. If you already have the Motorola strip transmitter and a schematic and tune-up information on it, you are a long way along. If you have not already put it on some frequency on 2m, I suggest you do so and be sure it is all running right before you add this frequency unit. In fact, I would suggest you choose your favorite frequency and crystal up for it and leave it as F1. Then add an F2 deck modified to an amplifier as shown, so you have a backup if something fails, and a constant other normal oscillator source to compare to during the tune-up of the new unit. This way you can shift back and forth between the two sources to assure all is well during hookup.

The new unit works because it was designed very much for and around the unit it was intended to drive – the Motorola strip. Therefore, a word of introduction to that unit, and my apologies if I can't guarantee its perfect operation right off the bat with other units. The GE tube transmitter should be a very good substitute; however, I don't have one to try it on.

The strip used was a 30 W, single 2E26 final, 1 to 3 frequency model of the PA8664 chassis type. It requires an oscillator of 6.0 to 6.166--- MHz for the output frequency to fall within the 144 to 148 MHz band. It should be noted and remembered these strip units are not broadband, and the 144 to 148 MHz figures are given for the new frequency unit's normal range. The transmitter should be peaked or stagger-tuned over the range you really intend to use (i.e., the 146 to 147 MHz range for me).

It should be pointed out that this is a digital VFO (VCO? – DVFO?) unit of sorts, and as such can be used with any number of tube type transmitters – FM or not!

One of the reasons this unit works is the very scheme that Motorola uses to get from the 6 MHz oscillator region to the 2m output (high band 150 to 174 MHz in their case). The multiplication scheme on these transmitters is oscillator times 24, but it happens as oscillator, doubler, tripler, doubler, doubler, to output. This is an important fact that is causing problems working out a similar scheme for the 6m and 450 MHz gear in the same cabinet. When you follow through the scheme I used, you will no doubt see what I mean.

The frequency unit runs a VCO oscillator in the 36 to 37.5 MHz range that is controlled the same as our "digital HFO" used on the EME BC-348s. Any VCO is dc controlled and our dc source is an FET-capacitor combination that has two separate and discrete electronic charge and discharge switches. Possibly the best part of using a dc controlled VCO is the fact that digital scanning, AFC, etc., can be added to these VCOs at a later date if desired. We don't want all this in the base FM station, but you will be able to see how it can be done as I manage to get the "Junque" series on BC-348s completed and turned in to *73 Magazine*. In fact, you will see a lot of the same circuitry used on a more than one item basis around here. This allows "modules" to be built, and repetitive results to be obtained time and time again.

Assuming the 36 MHz VCO works for the moment, let's carry that on out to the point it can run a transmitter. The VCO is quite capable, given the proper range, to run any 6m, 2m, or 450 MHz Motorola strip station. The dial in frequency comparison is where the hitch creeps in, so let's show how the VCO works on all first. The 2m transmitter, which I have mine running for, starts at the 36 MHz VCO and goes to a TTL gate and buffer to square up the VCO output for further TTL processing. From the buffer, in the transmitter chain direction, it goes to a divide by 6 TTL IC (7492) and has an output of 6.0 to 6.166--- MHz. It is best to do the divide by 6 as a divide by 3, then divide by 2, for a symmetrical square wave output. The transmitter is usually narrow enough, and the feedline to transmitter

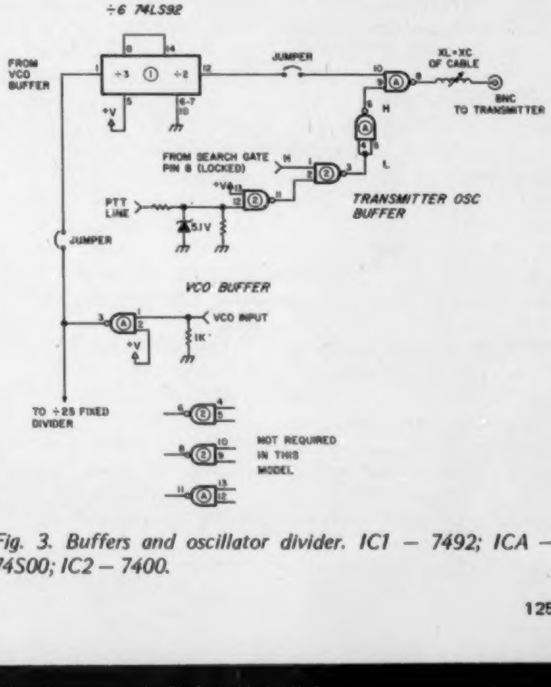
÷6 74LS92
FROM VCO BUFFER
÷3 ① ÷2
+V
6-7 10
JUMPER
XL=XC OF CABLE
BNC TO TRANSMITTER
H
L
FROM SEARCH GATE PIN 8 (LOCKED)
PTT LINE
5.1V
TRANSMITTER OSC BUFFER
JUMPER
VCO BUFFER
VCO INPUT
1K
TO ÷25 FIXED DIVIDER
NOT REQUIRED IN THIS MODEL

Fig. 3. Buffers and oscillator divider. IC1 – 7492; ICA – 74S00; IC2 – 7400.

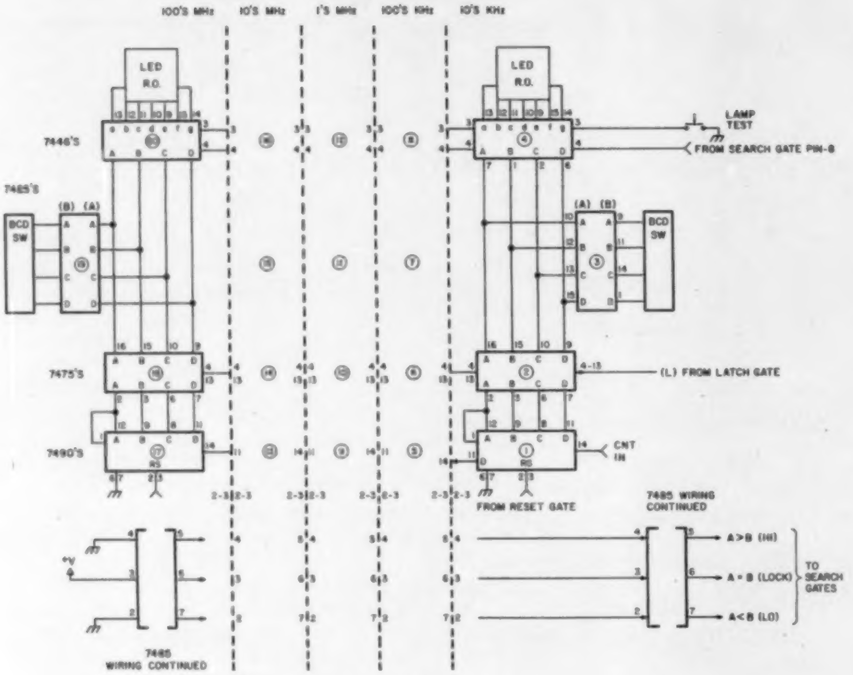

Fig. 4. Counter/comparator.

good enough, to remove the undesired harmonics of a square wave, but I did not want to chance that on a pulse type asymmetrical waveform you get from a divide by 2, then divide by 3. This is entirely unimportant for waveforms feeding more TTL, as only the high to low transition is important. The output 6 MHz signal goes through a buffer and gate for those who may find it necessary to shut off the oscillator output to the coaxial feedline to the transmitter (one feedline to more than one transmitter – choose frequency according to transmitter and transmitter by what PTT line is keyed).

The other direction the signal goes from the VCO buffer is to a divide by 25 in the form of a divide by 5, followed by another divide by 5. This is desired because the VCO runs at ¼ of the transmitter frequency, and dividing it by another 25 gives a total division by 100 and the same numbers as the output frequency only at 1/100 the frequency. This all allows a digital comparison to be made between this new 1/100 frequency and the BCD frequency select switches. Please note: The fact that this divided frequency and the switches match will show a "lock" condition and will run a transmitter by supplying it the proper oscillator frequency, but does *not* assure in any way that you are on frequency at the output any more than plugging in the right crystal does. All stages in the transmitter must still be properly tuned to proper multiplication frequency. The "lock" indication provides only the indication the VCO has moved to the correct new frequency and it is outputting to the transmitter. Gates are provided to allow no output while searching or out of lock and, of course, the provision of no output until keyed is included.

Bearing in mind that by keying oscillator output on and off, or to different transmitters, or holding it off during search, you will not be keying the oscillator VCO on and off, you can see that chirp and run-up is no problem. The oscillator is always running, and when it reaches proper frequency and the "lock" or transmitter ready indication shows, it merely means the oscillator output is gated on and frequency is being fed to the strip oscillator now converted to an amplifier. Some who read through the notes on this article shrieked at oscillator chirp and Class C stages running without drive in the transmitter, etc. For your, and their, piece of mind, this paragraph was added.

We are now down to the count and compare lines, and it is here the sneaky part enters. By feeding a 1.4 MHz region signal to what really is a frequency counter with a comparator added, a number that is 1/100 the output is counted. Since only the most significant 5 digits are important, that is all we count, by using a gate time of .01 second instead of 1 second. If a 1 second gate were used, the counter would overflow, too much time would be required to set up and keep comparing the VCO to keep it on frequency, and this scheme just plain becomes less feasible.

Let's take an example to show what goes on. 146.94 MHz is a common frequency, so let's follow it through. Since the VCO runs at the ¼ frequency, this means 146.94 MHz divided by 4 or 36.735 MHz. Divide this by 6 (to get the oscillator range frequency) and you have 6.1225 MHz. Multiply this by 24 in the transmitter and you have the 146.94 MHz output. Returning to the VCO frequency of 36.735 MHz and dividing by the fixed divide by 25 ICs, we have 1.469400 MHz to feed the counter. If you use a .01 second gate, then the counter will count and load .01 times 1.469400 MHz, or 14694 Hz. If the switches are set up for 14694, then, and only then, will the lock indication come on showing the delta dc module is not being turned on to charge or discharge, a fixed dc is being applied to the VCO, and a steady frequency is leaving the VCO that when divided by 6 is giving the right 6 MHz region oscillator signal. The nice part of all this versus frequency multipliers is that TTL division is quite fixed by the device when wired correctly. A divide by 6 is a divide by 6, etc.

You may have noted that the range of the VCO is all that limits how far you go on excursions with the VCO counter/comparator portion. Further, there is no need for fancy VHF PLLs, or dividers, or multiple PLL-mixers, etc. This alone made it worth trying for me. The very idea of an analog circuit where a digital one will work has a bad taste for me. I guess it is the fact it is so much easier to build, troubleshoot, maintain, etc., digital circuits, since everything is either on or off!

Now I mentioned earlier the idea was to run this whole thing as a digital master oscillator for all 3 bands (and later ideas of 1296 MHz FM!), but there came a few snags I am still working on. Let's take

6m first. The band of interest is 52.5 to 54 MHz and the Motorola strips require a 3 MHz region crystal and a times 16 multiplication. This band *can* be done as follows, and can even be added in as on mine, but bear in mind as with any versatile scheme, you will be capable of out of band operation, so be careful and pay attention to what you are setting up if you try it!

To get the same scheme to work on 6m, we let the same general region function for the VCO, but the VCO frequencies of interest are from 39.375 MHz to 40.5 MHz. These are then divided by 3 to get 13.125 to 13.5 MHz. These 13 MHz region frequencies are at ¼ of the transmitter output, the same as some frequency of the chain was for 2m. Therefore, dividing from this point gets you another 1/100 frequency if you use the same fixed divide by 25 pair used on 2m.

Again, let's use a common example, 52.525 MHz. Divide by 4 to get a VCO divided point of 13.131250 MHz, times 3 is a VCO of 39.393750 MHz. So, you divide the VCO by 3 to get the split point. In one direction you divide by 4 again to get the transmitter oscillator of 3.2828125 MHz. Toward the switch deck you do a fixed divide by 25 to get 525250 Hz. Since only one digit (the last) is insignificant here, we have to use a .1 second gate and settle for the slower lockup and less frequent comparison and updating of the VCO. Remember, this is still 5 updates a second, so you aren't going to drift very far with any VCO stability at all. The same switch deck is used to "dial in" the 52.525 MHz frequency as 052525. Since the gate is .1 second, it allows .1 times 525250 or 52525 Hz to pass into the counter, be compared, and match the dial in frequency.

Now the hard one! For 450 MHz, an 18 MHz region oscillator is required. This is easy enough by dividing our 36 MHz VCO by 2, so let's follow on through the range and a particular frequency. The range required (to cover it all) is from 420 MHz divided by 24 times 2 equals 35 MHz (not bad) to 450 MHz divided by 24 times 2 equals 37.5 MHz (again, okay). You do a divide by 2 to get the frequencies required by the transmitter from the VCO. Now to get a way to find the 1/100 frequency. To get down to the VCO frequency in the case of 2m, and to a lesser frequency in the case of 6m, only a division by 4 was required, allowing a further division by 25 for the 1/100 frequency for the switch deck. This gets tricky on the 450 MHz band, as any division that gets us to the VCO or less has an oddball divisor to get the 1/100 count. Further, suppose we run a divide by 10 approach to run the VCO from 42 to 45 MHz? Now an oddball divisor is required to get the 18 MHz required by the transmitter! We did not try to get any other crystal range, etc., for fear of not ending up right in the modulation department, but it is being looked into (i.e., a 6 MHz oscillator for all 3 bands, or even just 2m and 450 MHz).

This one will have to wait for now, unless you are willing to figure out the few places you run on 450 MHz and what those frequencies are when divided by 3 (or the 2m region equivalents). Example: If you take the 449.1 MHz simplex frequency, you get a 149.70 MHz "dial in." This is a VCO frequency of 37.425 MHz. This is well within the VCO range. A simple VCO to divide by 2 to a gate-buffer will supply the required oscillator frequency. A high band/UHF bandswitch would have to be added to control the destination and division from the VCO, and a small chart somewhere on the front panel to show the more commonly used UHF frequencies in 140 MHz equivalents. It would be wise to add in a panel lamp to show the band status anyway. The hundreds MHz A line can easily be used for this on the 6m band, as the low on the A line can be inverted and used to enable the 6m oscillator-gate-buffer, and the A line high can run the equivalent gate directly on 2m. You can even use the C line (4) if the switch scheme can be figured out for the 450 MHz use.

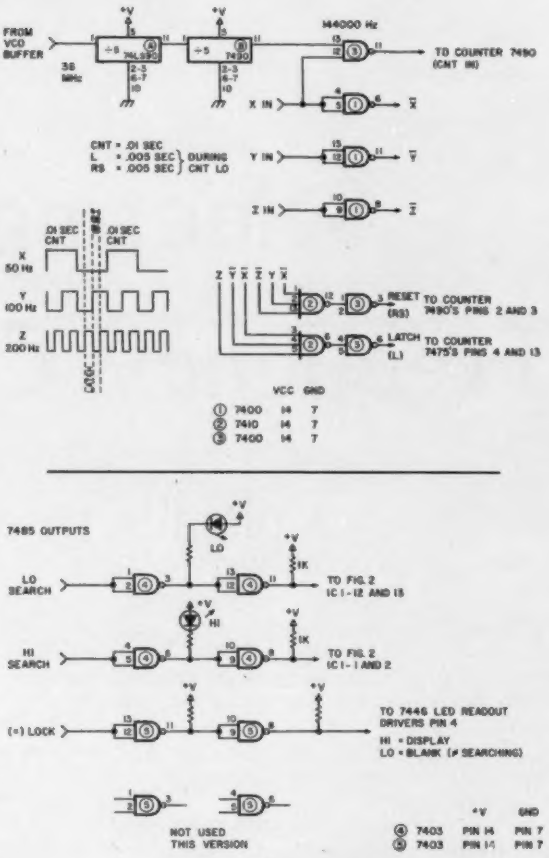

Fig. 5. Timing search.

I believe this describes the how to, and a wire by wire shouldn't be required. Enough counter articles have come out to explain the 7490-7475 counter part, the 7490 timebase (we run one master for a lot of things in the station – clock, etc. – to save duplication and money), and the time gating arrangement. Only the 2m version is shown to avoid confusion, but as the 450 MHz version is worked out or as interest demands, maybe a future article will include the other 2 bands – I have left provisions!

SASE for help. The "Junque" BC-348 articles will resume. Happy TTL, and I hope you are learning as you build. It can be a lot of fun, and if you don't think the electronic industry doesn't think digital is the way to go – look again! ■

Note: The modifications required to change over the oscillator tube in the FM strip will vary with the model, type, and whether Motorola or GE, etc. All that was required on mine is as follows:

1. Remove C105 (150 pF)
2. Replace C101 (50 pF) with .02
3. Remove C102 (10 pF)
4. Install 220 Ohm resistor in parallel with R103 (47k)
5. Install BNC or like connector near crystal socket on new F2 deck, and wire center pin to grid of 6AK6 added as second (F2) oscillator (now an amp).

Gary McClellan and Co.
Box 2085
1001 W. Imperial Hwy.
La Habra CA 90631

Selecting A Frequency Counter

- - pitfalls to avoid

Thanks to microcircuits, there has been a major revolution in test equipment within the last few years. The prices of devices such as digital voltmeters, triggered sweep oscilloscopes, and others have dropped dramatically, a neat trick considering inflation! But more important, this excellent, low cost gear is getting into the hands of servicers and electronics enthusiasts where good equipment is both useful and necessary to cope with today's advanced products. The frequency counter has also benefitted from microcircuits and price cuts, but only recently has it begun to "take off" with electronic hobbyists and service people. I think that this may be due to the past high prices, and a misunderstanding of what a frequency counter can do. But these things are going to change as more people are discovering what a counter can do for them!

I am going to show you some of the things to look for when you shop for a counter, and some of the not-too-obvious pitfalls to avoid. There's a lot more than specs to consider, too — all counters have special features that may be obvious or not in the advertising literature. In short, I am going to try to make your selection a better one by showing the more important *general* features and explaining them, so you'll know what to look for. As for myself, I work for a company that makes counters, and I have to use them nearly every day. So I am in a very good position to help you!

GARY MODEL 300 AUTOMATIC FREQ. COUNTER
OR
MHZ
KHZ
AC
KHZ
MHZ
AUTO
INPUT

Some of you skeptics are probably thinking, "Why do I need a counter?" A good question, indeed. Have you ever designed/built an oscillator and couldn't find the frequency? Then spent hours pruning the circuit to the proper frequency? A counter would tell you where you are at a glance. Or have you ever aligned a filter or trap or i-f stage and found that the center frequency was a city block off? A counter would help you keep tabs on the calibration of your signal generator and get a better alignment in the bargain! Have you ever had trouble accessing the local 2 meter repeater? A counter can tune up that tone generator in a jiffy. Ditto the transmitter with a VHF counter. Or, perhaps you are a CBer and people complain that you "bleed" on several channels. This could be caused by a sick transmitter with a bad crystal(s). A qualified technician can easily check this out with a good counter. Anybody still skeptical? Remember that you can do far more with a counter if you put your imagination to work!

A Wee Bit of History

You might be interested in how frequency counters evolved. The first method of frequency measurement evolved around the turn of the century when it was necessary to measure the frequency of radio transmitters. The gadget was called a *wavemeter* and it consisted of a paralleled coil, variable capacitor, and spark gap (later replaced with a meter or light bulb). The capacitor had a calibrated dial, and it was adjusted until a spark appeared at the gap. The frequency was either read off the dial or extrapolated from a coil/capacitor chart if the dial read pFs. By the '30s, another form of frequency measurement came into vogue: the *frequency meter.* This unit had a built-in frequency standard and the unknown was mixed with it; the meter was adjusted until the signals "zero beated" in the headphones that were part of the unit. Old-timers will no doubt recall the

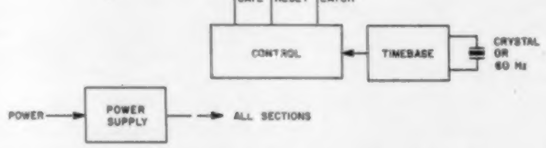

Fig. 1. Block diagram of a basic counter. The circuitry of modern counters is in ICs — mostly 20 to 30 packages of TTL.

BC-221 and LM frequency meters of WW II vintage with this mention — they were very famous! Digital electronics was the next development, and a digital frequency counter appeared in the early '50s. The first ones had 40-plus tubes, had neon lamps arranged in 0-9 columns for a readout, and were called EPUTs (Events Per Unit Time meters). The top frequency of those early counters was only a few MHz at most, although VHF range extenders appeared quickly. The early manufacturers were Berkley Scientific and Hewlett-Packard. The next step was in the '60s when ICs became available. Counters became smaller and much cheaper, too. Many companies are still using these warmed-over circuit designs today, despite advances such as CMOS. Recently, one semiconductor company has introduced a "2 chip" counter, where all of the major parts of a 6 digit counter are on 2 LSI chips! Needless to say, the future has much to hold!

A Look at Basic Specs

You have probably looked over enough of the ads by now to realize that selecting the right counter takes some thought and an understanding of counter fundamentals. Without these things, you could end up with a 3 digit "toy" and have to align a generator that is 10 times more accurate, or a unit that is so versatile it does everything but makes the morning coffee (extra cost option), to check a phono oscillator. So, needless to say, the way to start is to sit down and analyze *your own needs.* Ask yourself such questions as, "What am I going to use a counter for?" and "What do I expect to be doing with my counter within a few years?" These questions will help you decide the *primary* features that you must have in the counter you select.

For example, suppose you are an experimenter and you like to work with audio circuits and TTL logic. This suggests that you should start looking for a counter with a 20 MHz maximum range, because that is probably the highest frequency you are working with (frequency limit of standard TTL). Accuracy probably isn't critical to you and you might be able to settle for a unit that is 0.03% accurate.

Or perhaps you are a professional servicer and you are getting into CB repair. Your requirements are more strict. Since CB is 27.255 MHz maximum, you need one of the popular 30 MHz counters. Also, you need a counter that is 0.001% or "10 parts per million" (abbreviated 10 ppm) accurate to satisfy FCC requirements.

Consider the future, too. If the experimenter upgrades to, say, CB, he'll need a faster counter. But there are devices such as *prescalers* to extend the range of counters at low cost. So, when the day arrives, he might only have to add a low cost black box to his counter.

On the other hand, if the servicer upgrades to commercial radio repair, he may have to replace the counter. Why? The frequency tolerance of commercial gear is often 0.0005% and that requires a counter of 0.00001% or 1 ppm. That spec is 10 times better than the old unit's! These are a few thoughts to keep in mind when you start your search for the right counter. Try to anticipate the future!

Let's list the primary specs of a frequency counter and then discuss them. *Note:* They are not necessarily listed in order of importance.

1. Accuracy
2. Input sensitivity
3. Minimum and maximum frequency range
4. Display
5. Power supply
6. Special features or options

Accuracy

The accuracy of a frequency counter is determined by a quartz crystal or sometimes the ac power line (60 Hz). Fig. 1 shows a block diagram of a simple frequency counter. As you can see, the crystal/60 Hz is divided in frequency to operate the rest of the counter; this entire section is called the *timebase.* The timebase (or TB, for short) is the heart of the counter and its accuracy determines the accuracy of the counter. Price is also a function of the quality of this section. You'll find counters that use the 60 Hz line as a frequency element that sell for up to $150, and you'll see units that have crystals in *ovens* (temperature stable enclosures) that sell for $6000 or more. The difference in accuracy is incredible: The 60 Hz TB counter will average 0.034% accuracy, the average accuracy of the 60 Hz coming out of the wall, to 0.0001% and better for the crystal oven unit! This is clearly one area where money talks. Typical counters run 0.005%

ON
MODEL 302
FREQUENCY COUNTER
CHECK
GARY

Inside a Modern Counter

The frequency counter is still undergoing some changes, as this photo of the Gary Model 302 Pocket Counter shows. You are looking at a 20 MHz, 4 digit unit that can be expanded to show up to 6 digits of readout. Power consumption is under 0.63 Watt, as compared to the 5 to 7 Watts required by a comparable TTL unit. The secret of this unit is hybrid construction of CMOS and TTL logic. The heart of this unit consists of 3 CMOS/LSI chips. The DCU section which many hobbyists would build with 12 or more chips is contained in one special CMOS IC. The timebase section has two more CMOS ICs, replacing at least 6 TTL chips. The front end or Schmitt trigger deserves special attention because the input amplifier is the hardest part to design in a counter. This one has an FET amplifier and a biased NAND gate that serves as a Schmitt trigger. Sensitivity is excellent — 50 mV at 20 MHz with this arrangement. As you can see, counters have changed quite a bit, and they will continue to do so as more people continue to show so much interest in them.

(50 ppm) to 0.001% (10 ppm). They use 4 MHz or 10 MHz crystals without ovens for low cost. These crystals are usually custom ground and the TB is carefully adjusted to get this degree of accuracy.

When you shop for a counter, try to get a counter with as much accuracy as you can to suit your needs. Remember you need at least a 10 ppm timebase for CB repair work, if that is your interest. The 60 Hz units are not for serious electronics work; 0.034% accuracy is terrible in the counter world. Anyhow, the few units available with these may be off the market by the time you read this!

Input Sensitivity

Another sign of a counter's quality is the sensitivity it has to measure the frequency under question. Fig. 1 shows an *input amplifier*, the section that has to do with the input sensitivity, and Fig. 2 shows a block diagram. The job of the input amplifier is simple: It amplifies the input signal and converts the signal to a corresponding set of pulses that is necessary to drive the counter's digital circuitry. The heart of the unit is the *Schmitt trigger*; it converts the incoming signal, which may be any kind of a waveform, into the necessary digital square wave. Generally, when you read input sensitivity specs, you must assume that the sensitivity refers to the minimum signal required at the maximum rated frequencies of the counter to get a steady reading. In other words, the specs are worst case. Generally, the sensitivity of most counters is not flat over frequency, hence the min-signal-at-max-frequency bit. Fig. 3 shows the sensitivity plot of the Gary Model 301 Counter, a 32 MHz unit. As you can see, the input sensitivity is not flat! But in this case, a non-flat sensitivity curve can work to your advantage: The high gain at audio frequencies allows use of devices such as microphones and magnetic pickups for organ tune-ups and tachometers. The lower gain at 32 MHz reduces the chance of overload by radio transmitters, too.

Typical input sensitivity is on the order of 10 mV to 120 mV for most counters. It is desirable to get a counter with slightly more than enough sensitivity to do the job; in most labs, 100 mV worst-case does fine.

You will also find a maximum input voltage spec on some units. This refers to the maximum voltage you can apply to the counter without damage. This is always the *peak* ac signal plus any dc that may be present in the signal. For example, suppose you are measuring the signal of a homemade oscillator directly at the collector of the output transistor. You have, say, 9 volts dc at this point, plus, say, a 6 V peak-to-peak signal: You are applying 9 V dc + 3 V peak or 12 volt worst case to your counter! Fig. 4. illustrates this. This spec isn't really important to you unless you work around high voltage tube circuits and moderate to high power transmitters. In this case, there are counters built with range switches (usually calibrated x1, x10, x100, etc.) for use around high voltages. Typical maximum voltages are 20 to 100 volts for counters without range switches and 500 volts for the ones with them. These voltages are rated at a counter's maximum rated frequency, where the maximum input voltage must be reduced to prevent damage to the input amplifier. At low frequencies, such as 60 Hz, most counters will handle 120 V ac without problem.

Min/Max Frequency Range

This is probably the most advertised feature of frequency counters. Everywhere you look you are bombarded with ads screaming, "30 MHz Counter," "80 MHz Counter," "Or How About A 250 MHz Counter . . ." and so on. Yet top frequency isn't all that important. A 30 MHz counter measures a 27 MHz signal as readily as an 80 MHz unit or even a 250 MHz unit or above. Yet, the price difference between these models can be at least several hundred dollars. All you are getting for the extra money of a faster counter is a unit with more capability. And that's fine if you sometimes need a counter to measure VHF signals; otherwise you can save money if you stick to a lower cost, lower frequency counter that will read the maximum frequency you expect to be working with. Remember, too, that low cost prescalers are available that divide the input signal by 10, so you can have your cake and eat it too! (Gary McClellan and Company now offers two counters with built-in prescalers. – Ed.)

An often ignored spec is the minimum frequency a counter will display. This depends upon the timebase and the sensitivity of the input amplifier. In order to get any accuracy from a counter when measuring slow signals, at least 10 Hz must be displayed on the standard MHz range switch set to *kHz* (actually 1 second gate time). Why? All counters have a built-in ± 1 count inaccuracy due to the circuitry. That's 10% of 10 Hz – in other words, your 10 Hz is 10% accurate! Also, TB errors show up in these digits, and can worsen or even improve accuracy at this point. The input amplifier sensitivity may drop at this point, too, making it hard to pick up low frequency signals. It's safe to say that the low frequency limit of most counters is 50 Hz for good accuracy (5x the minimum frequency is good test equipment practice) even though the counter will read lower frequencies. If you do a great deal of measuring at low frequencies, you should consider a counter with a 10 second gate time, or a unit with a frequency multiplier, notably the Heath IB-1103. They will give you a display such as 60.1 Hz (10 sec TB) or 60.030 Hz (IB-1103).

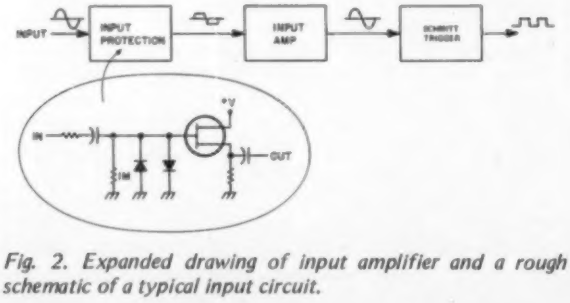

Fig. 2. Expanded drawing of input amplifier and a rough schematic of a typical input circuit.

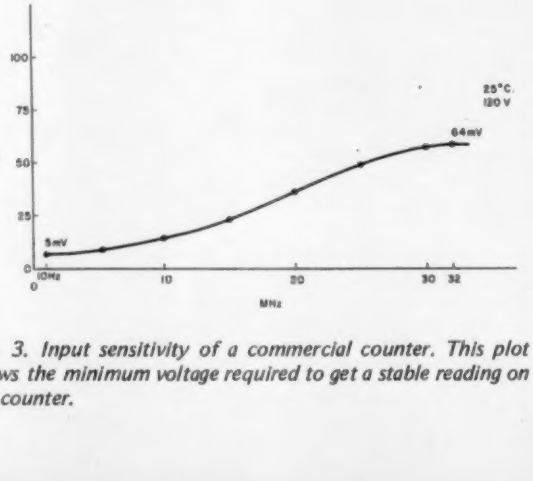

Fig. 3. Input sensitivity of a commercial counter. This plot shows the minimum voltage required to get a stable reading on the counter.

Display

The display on a counter can have a powerful bearing on whether you buy a certain model or pass it up. Important things here are the appearance of the digits and the number of them. LED type displays currently reign supreme in counters, so this is mostly what you'll see. Nixie tubes are seen in some older ac-only counters, but their use is dying out. Liquid crystals show promise for the future, because they don't require the high current of LEDs and the high voltage of Nixies. When you shop, look for the largest and brightest display you can get, but do not let the appearance of the display bias your thinking: Accuracy and sensitivity are far more important in determining your choice.

The number of digits should be considered, also. As a rule of thumb, five to six digits are about the optimum number. Fewer (such as the three digits found on an inexpensive kit) require complicated range switching or more knob turning for you. And more digits can be confusing to read. Ever see 146.96 MHz read out on a large counter as 146960001 Hz? It's very confusing at times. Also, large digit counters consume larger amounts of power; consider that if you are buying an ac/battery model!

Power Supply

Some counters offer you different ways to power themselves, often at no extra cost. The most common power source is 120 volts, 60 Hz. You'll find many units that can be wired for 240 volts ac, but you may have to check the operator's manual to find this out. There are also counters that have 120 V plus 12 V dc connections. You can often plug them into a cigarette lighter for working on mobile electronics. A few battery operated counters are becoming available, but at present none have the full features of the other models.

Special Features/Options

A whole plethora of special features are available on counters. Switching ranges from a simple kHz/MHz switch to a full blown range switch of 0.01 ms to 10 sec. Inputs range from simple jacks to complicated attenuators and trigger level controls. Input impedances may be different, too. You'll find the standard 1 meg plus 10 to 50 pF input and a straight 50 Ohm input (for VHF) on some units. Some of the more expensive units have timers/stopwatches and time interval measuring features built in. And the list could go on. Base your selection on what features you really need and not what looks nice. It makes no sense to buy a $300 counter/timer, then use the timer once and spend the rest of the time measuring frequency!

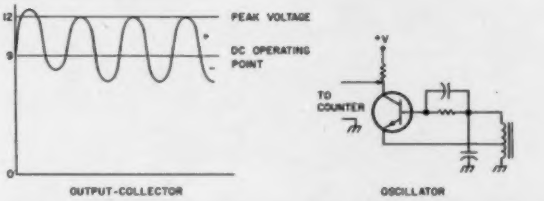

Fig. 4. Calculation of peak or worst case voltage that could appear across a counter input. Note sample circuit.

Most options can be quite useful. Some popular options include frequency range extenders, high stability TBs, power cords, etc. Also, don't overlook good probes and cables. A x10 scope probe is often used with the standard 1 meg input counter and will increase the maximum input voltage 10 times, preventing overload in most cases, and making connection to the equipment under test much easier. Needless to say, this is a very handy option and one that you should consider! If you feel that you must go for options, try to anticipate future needs. Sending a counter back to the manufacturer for modifications at a future date is usually much more expensive than ordering everything at the same time.

Some Pitfalls

Let's wrap this discussion of counters up by briefly mentioning some pitfalls that can trap you. In the past sections, I have mentioned problem areas and pointed out ways to avoid them. But here are some of the other areas to watch. Accuracy specs are sometimes hard to find on a counter data sheet, and when you do find them, they may not be complete! Although the data sheet may say "Accuracy: 10 ppm," nothing is said about the temperature or supply voltage, all of which affect the accuracy slightly. If accuracy is important to you and you are in this situation, it may pay to contact the manufacturer. Input amplifiers also have questionable areas. The input circuit of counters without attenuators should have an overvoltage protection network, usually diodes. Check. If the counter doesn't have one, avoid it or you'll be doing a lot of repair work on the counter! Finish up your evaluation by looking over the counter for any other features that you think will cause trouble.

If possible, try to get a "hands on" demonstration of the unit you select. Make sure that everything works to your satisfaction, and that the counter lives up to your expectations. With the information I have given you, the selection should be easier, as you should be aware of the *basic* things to look for in a counter. Good hunting! ■

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NOTES
1. Models prefaced ' ** ' will be available 1/77.
2. All models above are furnished with crimp/solder lugs.
3. All models can be furnished with a SO-239 female coaxial connector at additional cost. The SO-239 mates with the standard PL-259 male coaxial cable connector. To order this factory installed option, add the letter 'A' after the model number. Example: 40-20 HD/A.
4. 75 meter models are factory tuned to resonate at 3950 kHz. (SP) models are factory tuned to resonate at 3800 kHz. 80 meter models are factory tuned to resonate at 3650 kHz. See VSWR curves for other resonance data.

MODEL	BANDS (Meters)	PRICE	WEIGHT (Oz/Kg)	LENGTH (Ft/Mtrs)
40-20 HD	40/20	$49.50	26/.73	36/10.9
**40-10 HD	40/20/15/10	59.50	36/1.01	36/10.9
80-40 HD	80/40 + 15	57.50	41/1.15	69/21.0
75-40 HD	75/40	55.00	40/1.12	66/20.1
75-40 HD (SP)	75/40	57.50	40/1.12	66/20.1
75-20 HD	75/40/20	66.50	44/1.23	66/20.1
75-20 HD (SP)	75/40/20	66.50	44/1.23	66/20.1
75-10 HD	75/40/20/15/10	74.50	48/1.34	66/20.1
75-10 HD (SP)	75/40/20/15/10	74.50	48/1.34	66/20.1
**80-10 HD	80/40/20/15/10	76.50	50/1.40	69/21.0

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M11

J. H. Everhart WA3VXH
88 Knollwood Drive
Lancaster PA 17601

Build A Multiplying Prescaler

- - adds value to any counter

For several years I've been fascinated by tone signalling like subaudible squelch, touchtone,* tone burst and sequential tone paging systems. If I had been rich or lazy, I probably would have bought commercial modules for my experimentation, but since I am neither, I've been trying to build my own. One large advantage in buying any electronic device is that one needs a minimum of test equipment to get it working. However, if you "roll your own," the more sophisticated the performance you want, the more sophisticated your test equipment must be. Like most home experimenters, I have an oscilloscope and VOM and have managed to acquire an audio oscillator, power supply and ac millivoltmeter at relatively low cost at local hamfests. The one piece of gear I've been badly lacking is a frequency counter. Fortunately, there have been numerous construction articles for them in the last ten years in the ham and hobbyist magazines. The one I built is similar to the K2OAW counter.[1,2,3] This is entirely adequate for most uses an amateur has, but I wanted better performance at audio frequencies. This article describes the frequency scaler I came up with and details the design process I went through in achieving the final circuit. If you are interested only in the final product, please feel free to skim the article for details. But if you'd like to "look over my shoulder" to watch the design evolution, perhaps you can benefit from my experiences in your own ham projects.

Project Goals

What I wanted was a circuit to use with a counter to enable me to measure audio frequencies of 20 Hz or higher to within 0.1 Hz or so. For example, a widely used subaudible squelch tone is 114.8 Hz. I wanted to be able to measure this frequency and know that it was 114.8 Hz and not 114.7 or 114.9. The basic unmodified K2OAW counter will not do this. Its maximum resolution is 1 Hz. This is so because in the Hz mode it counts the number of cycles that occur in one second (see Fig. 1). Therefore, it would read 114 or 115 Hz because only that many cycles occurred. Being digital in nature, it cannot resolve fractions of cycles. (Because of the rounding off error of the gate there is a ± 1 count uncertainty. Unless otherwise specified, this will

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*AT&T trademark.

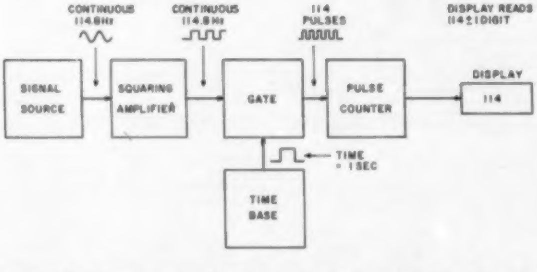

CONTINUOUS
114.8Hz
CONTINUOUS
114.8Hz
114
PULSES
DISPLAY READS
114±1DIGIT
SIGNAL
SOURCE
SQUARING
AMPLIFIER
GATE
PULSE
COUNTER
DISPLAY
114
TIME
= 1SEC
TIME
BASE

Fig. 1. K2OAW counter in Hz mode. Gate opens for 1 second, allowing 114 pulses to be registered in pulse counter and displayed.

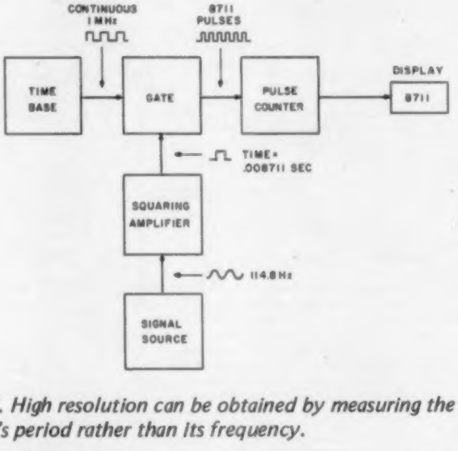

CONTINUOUS
1MHz
8711
PULSES
TIME
BASE
GATE
PULSE
COUNTER
DISPLAY
8711
TIME=
.008711 SEC
SQUARING
AMPLIFIER
114.8Hz
SIGNAL
SOURCE

Fig. 2. High resolution can be obtained by measuring the input signal's period rather than its frequency.

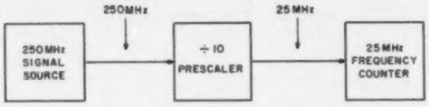


Fig. 3. Using a (dividing) prescaler to extend the high frequency capability of a simple counter.

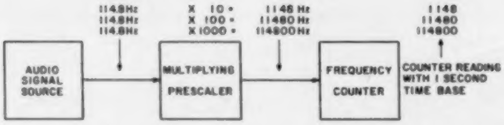


Fig. 4. Using a multiplying prescaler to improve measurement resolution at low frequencies.

be assumed for the rest of this article.)

The simplest method of gaining added resolution is to allow the gate of the counter to remain open longer so that it will pass more pulses. To get 0.1 Hz resolution means that the gate would have to allow 1148 pulses to go through; thus the gate time would be 10 seconds rather than 1 second. This approach works and has been used in frequency counters for years. But 10 seconds is a long time to wait for a reading. In fact, in the K2OAW counter, the update would take 20 seconds because of the nature of the gate circuitry. When you're setting an oscillator or filter on frequency, a 20 second wait between adjustments seems like an eternity. Needless to say, this simple method was not what I wanted.

Another way of quickly getting good resolution is to sort of turn the counter around. Instead of allowing the timebase to open the gate and pass the incoming signal to the counter section to be counted, it is possible to open the gate in response to the incoming signal and then pass pulses from the timebase to the counter section. Fig. 2 shows this setup. Here the input to the gate is a 1 MHz square wave from the counter's timebase. The input signal opens the gate, allowing the 1 MHz signal to pass to the counter section. At 114.8 Hz, the gate opens for 1/114.8 = 0.008711 seconds, allowing 8711 pulses from the timebase to be counted and displayed. This setup measures the *period* of the signal source in microseconds. To get frequency, you have to take the reciprocal of the period. So, 1/.008711 = 114.79738, according to my pocket calculator. Rounding off to the nearest tenth of a Hertz, we get 114.8 Hz. The period method, as presented, gives the required resolution, and gives fast reading updates, but it doesn't give a readout directly in frequency. Numerous commercially available frequency counters measure period. It can be handy to measure time, but it's awkward for frequency measurements.

Some frequency counters, like the Heathkit SM109 and the HP 5360 get around this problem by adding a "brain" to the basic counter. They are called "computing counters" and include logic circuits between their counter and display sections. The logic circuits take the reciprocal of the period and display a frequency readout directly. Anyone so inclined could interface a microprocessor or cheap calculator chip to perform the inversion. One brave soul has done just that.[4] His combined frequency counter, calculator, etc., is an elegant way to build a computing counter. But I already had a frequency counter and didn't need a little computer, too.

The scheme I finally decided on is analogous to the method used to extend the high frequency range of an inexpensive frequency counter. This scheme is known as prescaling. K2OAW used the prescaling technique to enable his 25 MHz counter to read up to 250 MHz. The method is shown in block diagram form in Fig. 3. The frequency counter won't operate by itself much above 25 MHz, because the ICs used operate too slowly. The prescaler, however, uses a special divider IC which will operate up to 250 MHz and produce an output at 1/10 of the input frequency. Thus, for 250 MHz input, the output is at 25 MHz, which the basic counter can handle. The price paid for this frequency range extension is in measurement resolution. If the input to the prescaler is 200,000,001 Hz, its output would be 20,000,000.1 Hz. With one Hertz gating, the 1/10 Hz digit would be lost, so the best resolution of this counting method would be 10 Hz at 200 MHz.

What does this loss of resolution at VHF have to do with added resolution at 20 Hz? That's simple. To gain low frequency resolution, we use a prescaler that multiplies the input frequency instead of dividing it. Fig. 4 illustrates the use of a multiplying prescaler. If the prescaler multiplies the input frequency by 10, the last digit of the output frequency corresponds to 1/10 Hz of the input frequency. Similarly, a x100 multiplier has an output corresponding to 1/100 Hz in the last digit. If the frequency counter uses a one second gate, then, a x10 multiplier gives 1/10 Hz resolution, x100 gives 1/100 Hz, and x1000 allows you to see 1/1000 Hz as the last digit of the input frequency. No sacrifice in counting speed is incurred, and the only arithmetic involved is remembering where the decimal point has to be placed in the counter's display. I wish I had thought of this method first so that I could patent it, but I'm years behind the test equipment industry. Systron-Donner and others for several years have manufactured frequency counters that use the same principle.

Now then, how do we multiply the input frequency by the right factor? Well, one way involves the use of a phase locked loop (PLL). Fig. 5 shows the block diagram of such a multiplying loop. The input signal is compared in phase with a signal from the divider shown, to produce an error output voltage. This voltage, in turn, is filtered and applied to a voltage-controlled oscillator (VCO). This voltage tends to retune the oscillator so that the output of the phase comparator is minimized. The net effect is to keep the frequencies of the two phase comparator inputs identical, but with a slight phase difference. The output of the VCO, however, is at 10 (or 100 or 1000) times the input frequency, and its frequency is locked to the input frequency. Thus, if the input is 114.8 Hz and a ÷10 divider is used, the VCO output is 1148 Hz, which is exactly the desired result. The above is an exceedingly oversimplified description of PLL operation, but it should

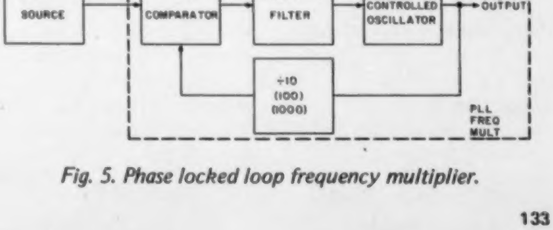


Fig. 5. Phase locked loop frequency multiplier.

Fig. 6(a). First circuit attempt of PLL frequency multiplier.

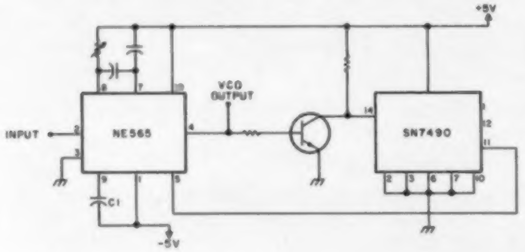
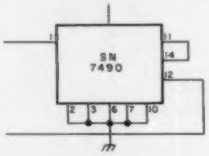


Fig. 6(b). Correct connections for symmetrical ÷10.



be adequate to demonstrate the multiplication principle. By the way, digital frequency synthesizers use the same basic principles with variable dividers to lock VHF signals onto lower frequency crystal oscillators.

Well, so much for the design concept. The thinking outlined above took lots of spare time over a six month period. After all that mental effort, I wanted to heat up my soldering iron and build something! The first attempt is shown in Fig. 6(a). The circuit was "borrowed" from a Signetics data sheet for the NE565 PLL chip. Component values have been intentionally omitted so that you won't be tempted to build it. Theoretical operation is the same as for Fig. 5. The input signal is applied to one input of the phase comparator via pin 2 of the NE565. The VCO in the 565 runs at 10 times the input signal frequency. The VCO output is divided by 10 by the 7490 and applied to the second phase comparator input via pin 5. The phase comparator output *should* try to lock the VCO at ten times the input frequency. It didn't. I tried different devices, readjusted component values, varied supply voltages, rewired the circuit several times, and nearly fried the 565 with too much input signal. But the #@*!! thing would not lock! At least it wouldn't lock at 10 x F_{in}. It liked 20x and 30x instead.

I had noticed, though, that it would lock at the input frequency if the divider was removed and pin 4 of the 565 was jumpered to pin 5. Similarly, locking was possible at F_{in} x2 with a ÷2 divider, F_{in} x4 with a ÷4 divider and F_{in} x8 with a ÷8 divider. This was a clue that something was wrong with the ÷10 section. The output waveform was perfect except for one thing: It wasn't symmetrical. It had a 20% duty cycle, since the output pin was high during only the last two input cycles out of ten. Very quickly I set up the 7490 for a symmetrical output as shown in Fig. 6(b). Finally, I could get the VCO to lock at ten times the input frequency. Further reading on phase comparators revealed that the doubly-balanced multiplier used in the NE565 likes to see signals with a 50% duty cycle. If it strays far from 50%, screwy things happen just like I had noticed.

Now that I had a working breadboard circuit, I wanted to see how well it would work. I tried to get it to multiply various frequencies in the audio range. One serious drawback very quickly appeared, though. The capture range was too small. That is, the circuit wouldn't lock onto a signal very far from its free-running frequency. For example, if it free-ran at 600 Hz, it would only lock from 450 Hz to 750 Hz or so. That meant that the multiplier would have to be coarsely tuned to the operating frequency each time it was used. Also, I was restricted to a 10:1 tuning range. The manufacturer recommends that R1 be between 2k and 20k Ohms. To cover the audio spectrum from 20 Hz to 20 kHz would require switching in 3 different values of C1 in addition to a "diddle" pot for fine tuning. This seemed awfully awkward. What I really wanted was a minimum of controls.

Just about the time I reached the impasse, though, I had a need to use some phase locked loop techniques at work. I had all sorts of practical knowledge from my lunchtime and evening work with the multiplier, so I dug out the textbooks, application notes and IC data books for some theory. After too much math and sore eyes from reading, I found that using a PLL with a doubly-balanced modulator phase detector wouldn't do the job. It's fine for relatively narrowband PLLs and works well with noisy signals, but had too many drawbacks to be practical for my multiplier. Something like the Motorola MC4044 seemed much more practical.

The 4044 is really a phase frequency detector. It consists of interconnected logic gates and flip-flops which give it an interesting characteristic. For signals close in phase on its inputs, it gives an output proportional to the phase difference between the two signals. But if the signals are not close in phase, it outputs a steady dc level. The second characteristic makes the 4044-type phase comparator far different from the doubly-balanced mixer. The 4044, in contrast to the 565-type comparator, is very useful for a wideband phase locked loop. Incidentally, it's also useful for narrowband PLLs, too. Many commercial frequency synthesizers use this IC.

The 4044, though, was of no use to me in my project at work. It simply consumed too much power. The system that I wanted to put the PLL in used all CMOS (Complementary Metal Oxide Semiconductor) integrated circuits, running at less than 5 V and consuming microamps of current. The 4044 needs 5 volts at 40 mA! Further research of the data books revealed the RCA CD4046. This was just the IC I needed, both for my work and home projects.

The 4046 is a CMOS IC which contains two phase comparators and a VCO. See Fig. 7. Phase comparator I is an exclusive OR gate which behaves like the doubly-balanced mixer phase detector. Phase comparator II, however, is what RCA calls an "edge-controlled digital memory network." Forget the long name. It's basically the same phase frequency comparator that the MC4044 uses. Phase comparator II is intended for use in wideband PLLs. The 4046 is almost like the NE-565 in low power form. And it's more versatile.

Now that I had a practical and theoretical background in PLLs, it took only a few hours to come up with the bare bones of the working multiplier as shown in Fig. 8. For a first attempt, I set the VCO just below 60 Hz and connected the VCO output (pin 4) directly to the phase detector (pin 3). Sure enough, when I applied a 60 Hz signal to pin 14 (the input), the VCO locked on and read exactly 60 Hz. Excitedly, I connected a CD4017 to divide by 10 and hooked it between pins 3 and 4 of the CD4046. Next, I replaced C1 with a new capacitor one tenth its original value. With no input signal, the VCO now read about 500 Hz. When the 60 Hz source was reconnected, the VCO read precisely 600 Hz! At long last, the multiplier was a reality.

Next, I calculated resistor and capacitor values per the RCA CMOS data book to tune the VCO over the range of 20 kHz to 200 kHz. For these values, the multiplier is useful over the usual audio range of 20 Hz to 20 kHz. For 20 Hz to 200 Hz, the VCO runs at 1000 times F_{in} and the required divider (Fig. 5) is a ÷1000. For 200 Hz to 2 kHz, the multiplication is 100 with a divider of 100. Finally, the 2 kHz to 20 kHz range is multiplied 10 times using a ÷10 between the VCO and phase comparator. Keeping the VCO tuning range constant and changing dividers is the most practical method of using the multiplier over the audio range. Little is sacrificed in having a smaller multiplication factor for the higher audio frequencies, though, since my method provides a constant resolution percentagewise over the whole range.

The original breadboard was wired up on an AP Superstrip.™ These strips are rather expensive (about $18), but are extremely useful for anyone who likes to experiment because you can try out a new circuit almost as fast as you can draw its schematic. Since the circuit was easy to change, I tried all three multiplication ratios just to be sure. This only meant changing a few wires, and I wanted to be sure that all was working on the breadboard. I wanted no surprises in the final version.

Now that the breadboarding was successful, I decided to build the circuit in final form and put it in a cabinet. I didn't want to bother with a PC board, since I was building only one, so I used the wire-wrapping technique. I used wire-wrap IC sockets (10¢ each at a hamfest) and 0.1 inch vectorboard. Wire-wrapping was accomplished with a $2.50 tool made by Cambion (their part number 45-1816-01-00-16). This tool, incidentally, is widely available at electronics parts houses. It's great for small wrapping jobs and costs less than $3.00, as opposed to $50 or more for motorized wrappers. At the same time that I hooked up the multiplier, I added an input amplifier which will be described later.

When I fired up the wrapped wire version, all sorts of strange things happened. First, the VCO kept locking up at the high end of its range without any input signal. This shouldn't be, because the phase comparator should have zero output with no input. And when I applied an input signal, the loop would try to lock, and then wander all over the place in seemingly random fashion. I was really perplexed because the breadboard had worked so well. My scope showed that there were pulses at the phase comparator output even with the input of the linear amplifier grounded! But when the input to the PLL IC was grounded, the pulses disappeared. Obviously, there was junk coming out of the linear amplifier, but I couldn't see it on my oscilloscope. I took the circuit into work the next day, to have a look at it with a decent scope. Sure enough, there were very narrow spikes being fed to the PLL IC even when the linear amplifier's input was bypassed to ground. I found that if the PLL IC was disconnected (pulled from its socket), the pulses went away. Now the light came on. The VCO signals from the PLL IC were being coupled to the linear amplifier by stray wiring capacitance. With the Superstrip, this coupling didn't occur, but wire-wrapping gives much more possibility of this stray coupling to exist. The linear amplifier was constructed from CMOS, so its high impedance inputs were very susceptible to capacitive coupling.

CMOS is extremely *insensitive* to noise when used in digital circuits, because the outputs are full "on" transistors at either ground or Vcc. However, the output impedances are much higher when the devices are biased in between to work as linear amplifiers.

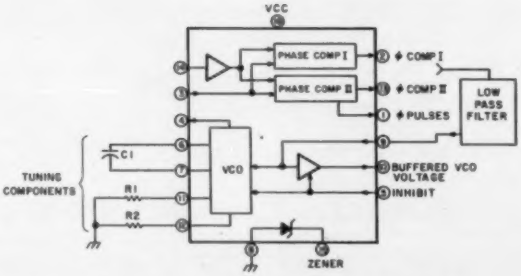


Fig. 7. RCA CD4046 phase locked loop IC.

To eliminate the problem of coupling, I built the input amplifier using point-to-point wiring on a piece of perfboard, leaving the PLL IC and dividers connected in wrapped wire fashion. The circuit behaved much better, although there was still a trace of VCO instability. This was cured by connecting the VCO tuning components R1, R2, and C1 to the IC with short-direct point-to-point wiring, and dressing the pulse-carrying wires away from these components. Apparently there had been the same strays noted earlier being induced into the VCO. Finally, everything worked well using point-to-point wiring for the linear amplifier and PLL IC, and wire-wrapping for the digital dividers.

When I got tired of the boards lying loose on the bench with wires dangling all over the place, I put it in a cabinet, a 2 x 4 x 6 shadowbox from Lafayette. Since then, two additional models have been built, and a half dozen or so sets of ICs substituted. All of them worked okay, except that one of the PLL ICs required a slight readjustment of the VCO range pot.

The Final Circuit

Several minor revisions occurred in the process of building the three packaged versions mentioned. Fig. 9 is the schematic diagram now that the design is "frozen."

The input circuit is detailed in Fig. 9(a). IC1 is a CD4001AE CMOS integrated circuit designed for logic circuits. In this application, it is an ideal amplifier and squaring circuit. The first gate, the "A" section, is biased as a linear amplifier by the 1.5 megohm feedback resistor. Input signals to it are ac coupled by two capacitors, and a sensitive control potentiometer sets the input level. The 47 pF feedback capacitor rolls off the amplifier's high frequency response to lessen sensitivity to stray pickup and high frequency transients. Gates B, C and D shape the input signal from a sine wave into a steep-sided square wave of about 5 volts p-p.

The phase locked loop section is shown in Fig. 9(b). IC2, the CD4046, is the actual PLL, while IC3, 4 and 5 are digital dividers. R1, R2 and C1 are the VCO tuning components. R1 sets the high

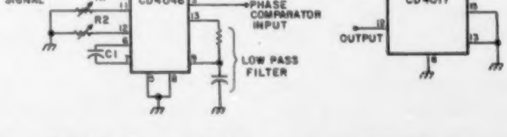


Fig. 8. Breadboard circuit for the successful PLL frequency multiplier.

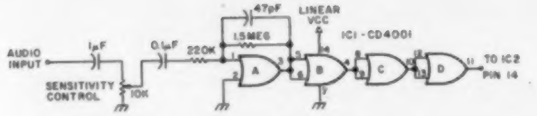


Fig. 9(a). Input amplifier and wave shaping.

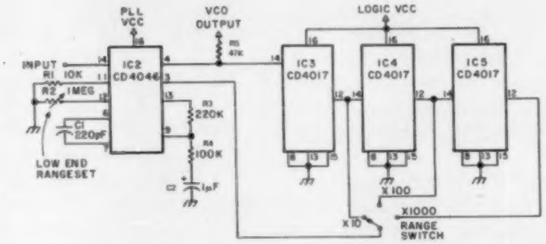


Fig. 9(b). PLL and logic for multiplier.

frequency end and R2 is used to set the low frequency end. Dc from the phase comparator output at pin 3 is filtered by R3, R4, and C2, and is fed to the VCO control terminal, pin 9. The VCO output at pin 4 is fed to the output connector through R5, which prevents loading of the VCO by the external frequency counter.

The output level is 5 volts peak-to-peak into an open circuit. IC3, 4 and 5 are each ÷10 circuits. Since the VCO tuning range is 20 kHz to 200 kHz, the output of IC3 feeds a 2 kHz to 20 kHz signal back to the phase comparator (pin 3) when S1 is in the x10 position. In this configuration, a signal in the range of 2 kHz to 20 kHz fed through the input amplifier is multiplied 10 times at the output terminal. Similarly, having S1 in the x100 position results in 100 times multiplication for inputs of 200 Hz to 2 kHz. And the x1000 position multiplies 20 Hz to 200 Hz signals by 1000.

Dc power is provided by the power supply of Fig. 9(c). A 9 V transistor radio battery is the prime source. This voltage is reduced to a regulated 5 volts by Q1, Q2, D1, and associated resistors. This is a pretty good regulator, by the way, for currents up to 20 mA or so. It stays in regulation until battery voltage drops to about 6.5 V, and is usable at inputs up to 20 volts. Decoupling is provided by the two 47 Ohm resistors, the 0.1 uF capacitors and the 5 uF capacitor, preventing interaction between the ICs through the Vcc lines. You may wonder why I used a discrete regulator rather than one of the new three terminal IC devices. Well, that's easy: a) I had the parts; and b) the IC versions don't work well at low current. Since the total circuit current drain is about 5 mA, I built my own regulator. The regulator circuit is copied from a design used in some industrial control equipment, so I claim no originality.

Construction

This is one project that does have critical parts layout. As I mentioned earlier, CMOS in logic circuits is noise immune, but CMOS in linear circuits is noise susceptible. The input amplifier and the IC2 wiring must be cleaner than the rest of the circuit. Point-to-point wiring on 0.1 in. x 0.1 in. vectorboard is fine, so long as the leads are kept short and direct. If you're ambitious, a PC board would be excellent. In any case, keep the wires with steep-sided pulses from the logic dividers away from the small-signal wiring of the input stages. Wiring of the divider stages and power supply regulator doesn't require any special precautions. In addition, it's a good idea to wire the audio input and VCO output lines with shielded cable to minimize any unwanted coupling. For guidance purposes, Fig. 10 shows the layout of the most recent point-to-point wired version. If you're ambitious and want a really neat construction job, a PC board version would be ideal — but so far I've been too lazy to build this multiplier that way. Incidentally, a metal cabinet is preferred as an enclosure to provide shielding, particularly if you plan to use the device around a transmitter.

Parts

In choosing parts for this project, I relied heavily on my junkbox. Admittedly, mine is probably better stocked with modern components than those of many other hams I know, but this is true only because I'm a hard core scrounger. I'll give you a few ideas about what components to use, but feel free to try those you have. If you substitute intelligently, your parts will work as well as mine.

The only really critical capacitor is the 220 pF capacitor used for VCO tuning. An ordinary disc ceramic will probably drift too much, even with the usual room temperature changes, causing the VCO lock range to vary from day to day. You should use a dipped mica or polystyrene capacitor for best results. The 1 uF input coupling capacitor should have paper or mylar dielectric and be rated at 100 V or so, since often you don't know what dc voltage you'll put on it making frequency measurements. The other capacitors of 1 uF or larger rating can be any electrolytic or tantalum types rated at 6 volts or more. All remaining capacitors can be disc ceramic types with 12 volt or higher voltage ratings. The CA4001 (IC1) and CD4046 (IC2) were purchased from James Electronics (a *73* advertiser) at reasonable cost. IC3, IC4 and IC5 are also available from James, but I took a cheaper route. The local Radio Shack store has been selling IC divider assortments for $1.98 (cat. no. 276-1607). They claim to be 100% functional devices, although I found a reject rate of about 20%. At any rate, several packs of them contained one good 7490 (a TTL device not used here), and several CD4017 and CD4018 devices each. For less than $4.00 (excluding tax), I got enough ICs to build two multipliers. Please note that the schematic in Fig. 9 shows the wiring for the 4017 dividers; if you have 4018 units refer to the RCA *CMOS Databook* for the correct wiring. If you are brave, try the Radio Shack assortment. If not, the devices are available from James and others at low cost. I recommend using sockets for all of the ICs. They often cost as much as the ICs themselves, but they make initial checkout and future troubleshooting much easier. The input potentiometer is a sensitivity adjustment; thus a panel-mounted control is most convenient. The VCO range pot, R2, can be a single turn PC mount device because its setting is not touchy. The remaining resistors can be ¼ or ½ Watt 10% carbon composition. The schematic shows a 1N5231 for the power supply zener diode. You can use any other ¼ Watt to 1 Watt device. The two transistors used in the regulator are not special. I've built this regulator in dozens of projects, and any NPN small signal silicon device such as 2N5172, 2N2222, 2N3394, 2N3904, or 2N4401 has worked equally well at this voltage and current level.

Checkout and Adjustment

When I designed the multiplier, I tried to make it as easy to build and use as possible. Ditto for adjustment. When you have it all assembled correctly, connect power, turn it on, and check

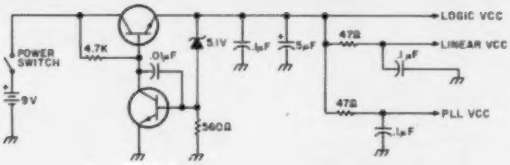


Fig. 9(c). Power supply regulator.

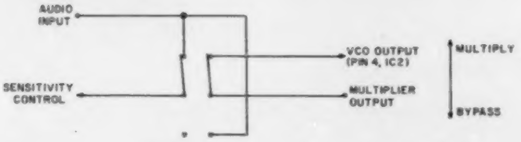


Fig. 9(d). Bypass switch wiring.

the power supply voltage at pin 14 of IC1 and pin 16 of IC2, 3, 4, and 5. When all is well, it should be between 5 and 6 volts. If not, disconnect power and check your wiring. Should you have any remaining problems, the simplest troubleshooting method is to remove the ICs one at a time while checking the Vcc line. Incorrect regulated voltage with all of the ICs disconnected means a gross wiring error or bad components in the regulator.

When all is well powerwise, connect a frequency counter to the VCO output. Temporarily short circuit pin 9 of IC2 to ground. With pin 9 at ground, the VCO free runs at the low end of its range. You should be able to adjust the VCO frequency as read on the counter, with R2. Set the low end frequency at about 15 or 16 kHz. Now connect pin 9 to Vcc. This puts the VCO at its upper end, which should be 200 kHz or higher. If it is not between 220 and 280 kHz, change the value of C1 slightly — more capacitance for lower frequency and vice versa. After either adjustment, check both ends of the VCO range to make sure there is some overlap (low end less than 20 kHz and upper end above 200 kHz). In my prototypes, any CD4046 I've tried will fall easily within the above limits.

Now you can make an operational check. First use a 60 Hz source, such as the output of a filament transformer. *Do not* use the ac line directly. The multiplier won't be damaged by ac up to 20 V rms or so, but you can be severely fried playing with the ac line. First, connect the frequency counter to the ac source directly to verify the presence of 60 Hz ac. Then connect the counter to the multiplier output and the ac source to the multiplier input. Set the multiplier range switch to the x1000 position. By adjusting the input level control, you should be able to get the multiplier to lock on, causing your counter to read 60000. The input level control is not at all critical above some minimum setting. Once you've gotten this far, it's probably best to get hold of a signal generator and check the multiplier over its whole range of 20 Hz to 20 kHz. Should you have difficulty getting the device to function properly, a good oscilloscope is invaluable, and the aid of a friend familiar with digital circuits is recommended.

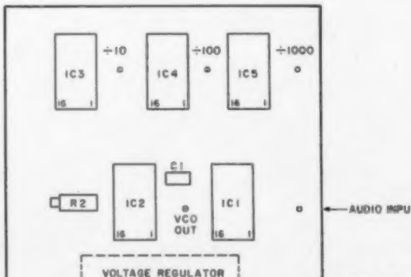


Fig. 10. Frequency multiplier parts layout.

Usage

A prescaling multiplier is a valuable addition to an ordinary frequency counter for fast, precise measurement of audio frequencies. Fig. 11 is a typical test setup for measuring the frequency of an audio oscillator. To set the multiplification factor of the prescaler, you must first know the approximate frequency of the signal being measured. To measure this quickly, set the prescaler's INPUT switch to the BYPASS position, so that the signal will go directly to the frequency counter. Taking note of the frequency, set the RANGE switch to the appropriate position. (For signals from 20 Hz to 200 Hz, use the x1000 range, for 200 Hz to 2 kHz use x100, and for 2 kHz to 20 kHz use the x10 setting.) You'll remember that there is some overlap in the ranges from the VCO tuning adjustment mentioned earlier. Now set the INPUT switch to the MULTIPLY position, turn the unit on and turn the SENSITIVITY control clockwise. If the signal is greater than 50 mV or so, the prescaler should lock on in several seconds and the frequency counter will read the oscillator frequency scaled up according to the multiplier setting. Thus, with an input signal of 50 Hz and the RANGE switch set for x1000, the VCO output is 50,000 Hz. With the frequency counter's timebase at 1 second, it will read 50000. Set at .1 second we get 5000, for .01 second 500, and finally, for .001 second the display reads 50. So by setting the counter timebase, you can tradeoff measurement resolution for faster updates. This makes setting the oscillator frequency much easier.

Final Comments

This has been a multipurpose article. Its overall purpose has been to present the circuit for a unique piece of test equipment. But, in addition, I've thrown in some theory and a bit of the background on how the device was conceived and implemented. Hopefully, it will prove valuable to brainy types who could come up with a similar gadget given enough time, and also maybe it will give some incentive to the average home builder who hasn't successfully gotten through the design of any modern circuitry. Whatever your background, I hope the article has been interesting and informative. At any rate, the frequency multiplier is easy to build and an extremely useful addition to any frequency counter. ■

References

1, 2, 3. Peter A. Stark K2OAW, "A Modern VHF Frequency Counter," *73 Magazine*, May, July, and September, 1972.

4. Robert Johnson, "The Calculating Counter," *73 Magazine*, September, 1975, p. 22.

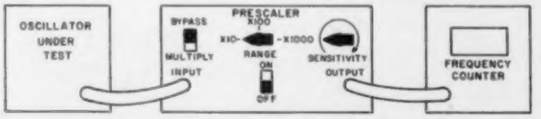


Fig. 11. Test setup for high resolution frequency measurement.

Phone Patch Tips

-- a lost art?

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Here are a few tips for you home brewers who have tried to build phone patches from scratch parts which for one reason or another never quite turned out right. I've built quite a few, and these are some tips I think you will find helpful.

The first problem is to connect the speaker to the phone for the person on the other end to hear. Then we have to connect the phone line to the transmitter. This can be done in a number of ways. One of the simplest is shown in Fig. 1. It is fairly common to find such a transformer on the surplus market, and it makes a quick and easy phone patch. I have one with a 500 Ohm, a 50 Ohm and a 50,000 Ohm winding. It works quite well, but it does have its drawbacks.

In the very simple patch the audio from the speaker is always connected to the phone line, so you must mute the speaker completely when you are transmitting. Any hiss in the receiver output will be transmitted along with the voice of the person on the other end of the patch. Also, when you are in the receive mode the receiver output is crammed back into the transmitter. This means that it will be impossible to operate VOX. In fact, some transceivers may share audio sections with transmit and receive, and this loud signal into the mike jack may crossover into the receiver section. A simple solution is to get a DPDT switch and use it to key the transmitter and mute the mike as in Fig. 2.

If you would like to avoid the hassle of having the switch or perhaps would like to be able to operate VOX, you want to go to a hybrid phone patch. There are several different types of hybrid phone patches. The hybrid patch usually uses one or two transformers (coils) which are connected in such a way that the signal from the receiver is coupled to the phone line but is cancelled by an opposite signal in the lead that goes to the microphone. Attenuation in a good hybrid is typically around 40 dB, or about one one-hundredth of the receiver output gets to the transmitter.

In the one coil hybrid in Fig. 3 the flux set up by the speaker winding in the transformer core produces a voltage across the secondary windings and across the phone line. Notice the capacitor. This keeps the dc from the phone line from flowing through the transformer windings and saturating the core. If this happens the transformer will behave unpredictably and most certainly will not give you a good null between speaker and mike. Now if we look carefully at the mike winding we see that when current enters the speaker winding (with the dot) it leaves through the mike winding with the dot making the ends of both windings positive. The voltage across the mike winding bucks the voltage across the speaker winding, so the speaker audio will be cancelled in the mike output. However, when a signal comes in from the telephone it sets up a flux in the transformer core which seems to set up the same situation for cancellation as the previous situation. Actually it does not. The secret is in the 430 Ohm resistor and the fact that the signal is coming from the phone line rather than the speaker. In this case the current from the speaker is flowing through the 430 Ohm resistor in the opposite direction. And so instead of bucking each other they add, and the signal gets through.

Fig. 4 shows a typical two coil hybrid. It achieves its nulling effect by using the two cross connected number 1 windings. The 2.15 uF capacitor and the 900 Ohm resistor are typical values for nominal telephone line impedance. To get the best match you could put a capacitance meter across the line and find the exact capacitance of your line and then use a variable resistor to find the best null between speaker and mike. One important thing to remember when adjusting the null or "balance" is that you should place a call to a friend when you do so. Your telephone line impedance looks different after you complete a call. The phasing on the number 3 windings are different for each installation depending on how many phase inversions take place in the audio sections of your rig. Flipping one of the leads over might help you get that extra couple of dB isolation if your patch doesn't quite work as well as you would like on VOX. But for the most part the phasing is unimportant. Otherwise T1 and T2 are identical hybrid type transformers. The capacitors "C" are both identical non-electrolytics about 1.0 to 2.0 uF.

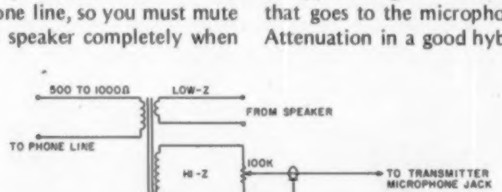

Fig. 1. Single transformer as a simple patch.

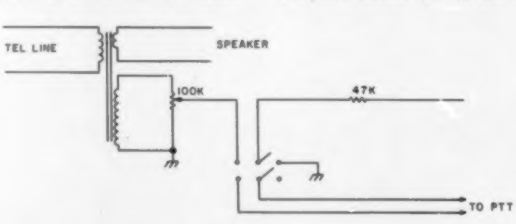

Fig. 2.

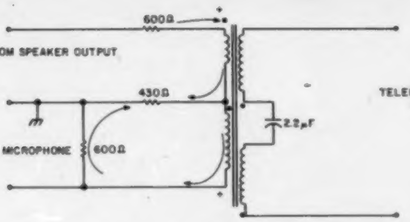

Fig. 3. One coil hybrid.

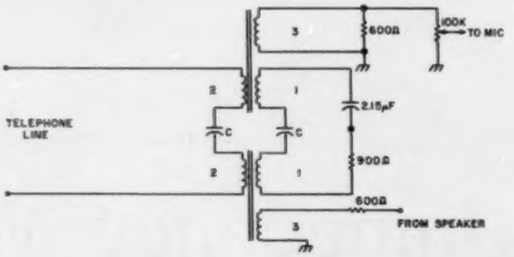

Fig. 4. Two coil hybrid.

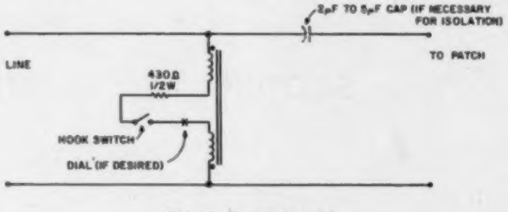

Fig. 5. Retard coil.

Again, it is very important to keep dc off the windings. But it is also necessary to provide a path for dc to keep the phone company equipment from seeing an off-hook condition and hanging up the phone. This can be done by simply keeping your phone off the hook, but any noise in the shack seems to come over much louder than the person on the other end of the picture. You could just slap a 500 Ohm resistor across the line, but that loads the patch. You have to crank up the gain, and you unbalance your hybrid if you are using one.

The phone companies have a real slick and simple solution for this problem. They call it a retard coil. All it amounts to is a 1:1 transformer with its windings set up to buck each other. Fig. 5 shows how a 1:1 transformer would be wired to act as a retard coil. By placing a switch in the center of the two windings you can go on or off hook as you desire. Place a dial in series with the switch and you can dial right from your patch. I have one set up like this, and it really works well. The resistor limits the current you draw from the line to a safe value. If your old homemade patch relies on current flowing through the patch transformer to hold it off hook put a 2 to 5 uF capacitor in series with your patch and try a retard coil to hold it. I'm sure you will find an improvement in frequency response. I used a cheap little 500 Ohm to 500 Ohm transistor transformer and it works fine.

Once you can hang up your phone during the patch you need some means to monitor the conversation so you can throw the switch or retune the receiver if necessary. Earphones work fine but you have to be careful about loading the line. Put a 0.1 uF capacitor (or larger) in series with a 2.2k resistor to your phones. Stereo headphones work quite well. Just connect the right and left channel in series by just using the two tips on the jack. No connection to the common or ground side is necessary. This works quite well and affords the people on the patch a little more privacy, or so it seems. (See Fig. 6.)

Store bought phone patches have nice meters on them to monitor audio levels. Regular VU meters are a little on the expensive side but they give a good indication. However, I chose to use one of the cheaper level meters you see advertised in ads in this magazine for $1.50 or $2.00. I ordered a couple from Poly Paks and found that they are about 140 uA full scale with 100 uA being about "0 VU." Plenty sensitive but they are dc meters. I used a diode bridge to rectify the audio. I used four germanium diodes and made it myself. Be sure you have germanium diodes. Their lower forward voltage drop (0.2 V instead of 0.6 V for silicon) makes them preferable for rectifying low voltages. Fig. 7 shows the finished meter circuit. The resistor R is a fixed resistor that is chosen experimentally to give the desired meter deflection. Again I urge you to keep it on the large side. If 3.3k and 3.9k both look pretty good choose 3.9k. This is best chosen by calling someone and having them tell you when the signal from the patch sounds like a comfortable listening level. Then change resistors until the meter peaks around two-thirds of the way up the meter face. You may want to put a switch in series with the meter circuit, so it will not peg out when you are dialing or when your phone rings.

Which brings up another interesting idea. If you are hard of hearing or have a high noise level in your shack and have the bell on the telephone in your shack turned down you can see your telephone ring by hooking a neon light across the line. The ac ringer voltage will light the light when the bell rings. Don't forget to put a current limiting resistor in series with the light. It can be a small light or a larger one that can be seen for quite a distance. (See Fig. 8.)

It's always a good idea to keep rf out of your patch and the phone lines. Fig. 9 shows a brute force type line filter. The ground shown should be a good earth ground. If you get rf into your meter try a 0.01 uF ceramic type capacitor across the terminals.

Following these tips and with good construction practices you should be able to come up with a very good phone patch that you can be proud of. Just remember to keep dc currents from flowing through your patch transformer. If nothing else put a 2 to 5 uF capacitor in series with the winding. Try the retard coil gimmick and phones, and see if the people you patch together don't like it much better. ■

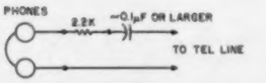

Fig. 6. Headphone monitor for tel line.

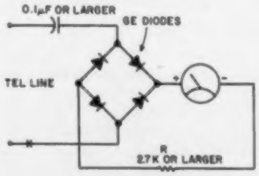

Fig. 7. Meter circuit.

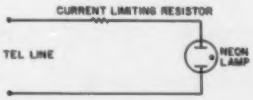

Fig. 8. Visual ringer.

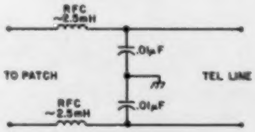

Fig. 9. Rf filter.

Impedance Matching

-- simplify a complex process

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In designing an antenna system or matching network, a radio amateur many times finds the need to measure the actual complex impedance of a transmission line, antenna, or network at the rf operating frequency. This can be done simply and accurately by using a directional wattmeter and various lossless mismatches constructed from capacitors, without the expense of measuring equipment such as network analyzers and RX bridges costing upward from several thousand dollars.

Materials Needed

– A directional wattmeter having the capability to measure forward and reflected power at the operating frequency. An accurate vswr meter may also be used.

– Transmitter or exciter capable of transmitting a CW signal at the operating frequency with enough magnitude to properly operate the power meter or vswr bridge. (The output impedance of the exciter should be equal to the characteristic impedance of the transmission line being used; in most cases, 50 Ω for amateur applications.)

– A dummy load of proper resistive impedance and power dissipation characteristics to terminate the output of the exciter, having a vswr of not more than 1.2:1 (not more than approximately 1% reflected power). The closer the load is to a 1.0:1 match, the more accurate the impedance measurements will be.

– Capacitors, silver mica, not less than 500 WV dc (see text).

– Coaxial cable for connection of the exciter to the input of the wattmeter or vswr meter, having a characteristic impedance of that of the exciter (usually 50 Ω for amateur applications).

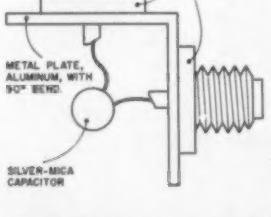


Fig. 1. Construction of capacitive mismatches for impedance measurements.

Construction of the Capacitive Mismatches

The capacitors used should provide an imaginary impedance of approximately -j0.5 to -j3.0 at the operating frequency. This means that the range of reactance of the capacitors used can be from $0.5Z_0$ to $3.0Z_0$.

In a 50 Ω system,

$$0.5Z_0 = 0.5(50\ \Omega) = 25\ \Omega \qquad 3.0Z_0 = 3.0(50\ \Omega) = 150\ \Omega$$

So, the capacitive reactance can range from 25 Ω to 150 Ω at the rf operating frequency for a 50 Ω system (see Table 1).

Calibration Procedure

1. Construct measurement circuit as shown in Fig. 2. Select two capacitors that fall in the proper capacity range for the frequency at which the impedance measurement is to be made.

2. Measure and record the vswr of the load with each capacitor in the circuit. If the wattmeter used does not have an swr scale, refer to Fig. 3.

3. Draw a constant vswr circle on the Smith chart for each of the vswr measurements taken with the capacitors in the circuit.

4. Find the point along the resistance circle, R=1, where intersection with each of the constant vswr circles occurs.

5. Record the value of each of the reactive components at the points of intersection, (-jX). These values are the reactive values of the capacitive mismatches that are to be used in measuring complex complex impedances at the rf frequency at which the calibration was made.

Impedance Measurement

1. Construct measurement circuit as shown in Fig. 4. Measure and record vswr of the load.

2. Construct measurement circuit as shown in Fig. 5. Measure and record the vswr of the load in series with each of the capacitive mismatches.

3. Plot and label the vswr circles of the measurement of the load vswr and the vswr of the load plus each of the series mismatches.

4. Find the resistance circle on which ∆jX (the change in jX) between the load vswr circle and the load-plus-mismatch vswr circles is equal to that of the value recorded for each value of -jX recorded in the calibration measurement.

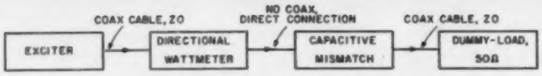
5. Follow the resistance circle to the point where it intersects the vswr circle of the load only. This point of intersection is the value of the complex impedance of the load, R + jX.

Example

The frequency at which

Amateur Band	-j0.5	-j3.0
80m	1700 pF	280 pF
40m	890 pF	150 pF
20m	450 pF	75 pF
15m	300 pF	50 pF
10m	220 pF	37 pF

Table 1.


COAX CABLE, ZO
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COAX CABLE, ZO
EXCITER
DIRECTIONAL WATTMETER
CAPACITIVE MISMATCH
DUMMY-LOAD, 50Ω

Fig. 2. Measurement circuit for calibration of the capacitive mismatches at the rf operating frequency.

$$\text{swr} = \frac{1+p}{1-p}$$

$$p = \log 10^{-1}\left(\frac{10 \log 10 \left(\frac{P_{\text{forward}}}{P_{\text{reflected}}}\right)}{-20}\right)$$

Fig. 3. Conversion of forward and reflected power to vswr.

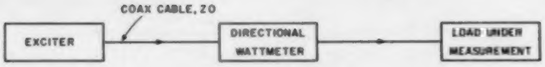

COAX CABLE, ZO
EXCITER
DIRECTIONAL WATTMETER
LOAD UNDER MEASUREMENT

Fig. 4.

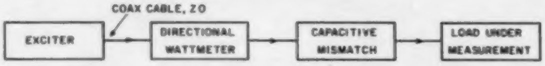

COAX CABLE, ZO
EXCITER
DIRECTIONAL WATTMETER
CAPACITIVE MISMATCH
LOAD UNDER MEASUREMENT

Fig. 5.

the impedance measurement is to be made is 14.250 MHz.

The value of the capacitors in the two capacitive mismatches, ZX_1 and ZX_2, equals:

Capacitor, ZX_1 = 400 pF
Capacitor, ZX_2 = 120 pF

Calibration (50 Ω system)

1. Measurement circuit in Fig. 2 was constructed. Two capacitors were selected for use in the capacitive mismatches, corresponding to the limits specified in Table 1.

2. The vswr of the dummy load plus each of the capacitive mismatches was measured and recorded.

vswr, ZX_1 + load = 1.8:1
vswr, ZX_2 + load = 5.2:1

3. Constant vswr circles were drawn for each measurement. See Smith chart A.

4. The points of intersection with the R=1 resistance circle were found and labeled, points A and B.

5. The value of each of the reactive components of ZX_1 and ZX_2 were recorded from points A and B of the Smith chart.

$ZX_1 = -j0.62$
$ZX_2 = j1.85$

Impedance Measurement

1. The measurement circuit in Fig. 4 was constructed. The vswr of the load was measured and recorded.

vswr, load = 2.5:1

2. The measurement circuit in Fig. 5 was constructed. The vswr of the load plus each of the capacitive mismatches was measured and recorded.

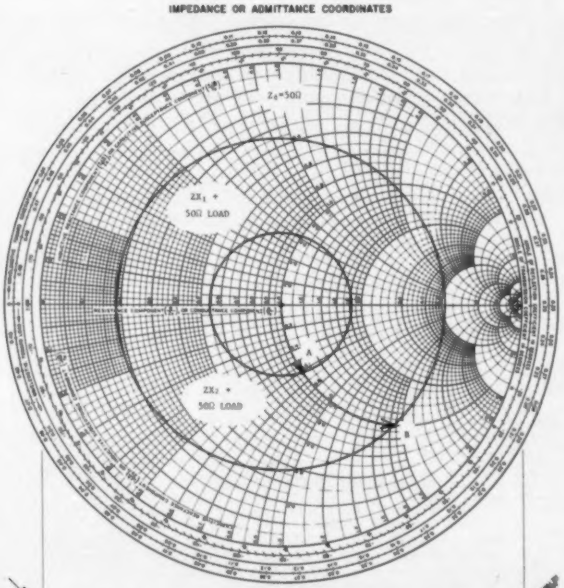
vswr, load plus ZX_1 = 1.78:1

vswr, load plus ZX_2 = 5.2:1

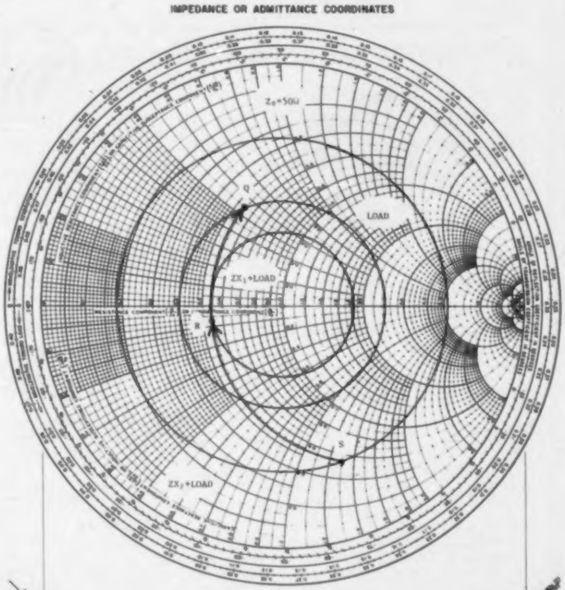
3. Constant vswr circles were plotted for the measurement of the load vswr and the vswr of the load plus each of the series mismatches. See Smith chart B.

4. The resistance circle on which ΔjX between the load vswr circle and the load-plus-mismatch vswr circles is equal to that of the recorded value of $-jX$ found in the calibration measurement located on Smith chart B. ΔjX between points Q and R = $(-j0.62) = 0.62$. ΔjX between points R and S = $(-j1.85) = 1.85$.

5. The $0.55Z_0$ resistance circle is drawn from point S to point Q, as indicated by the arrow. Point Q lies on the vswr circle of the load only, so point Q is equal to the value of the complex impedance of the load, R + jX. So, the load impedance = 0.55 + j0.55. ■



Smith Chart A.



Smith Chart B.

GENERAL MULTI-PURPOSE V-O-Ms • DROP RESISTANT • HAND SIZE • MODEL 310 V-O-M • TYPE 3

TRIPLETT
OHMS

Model 389
Cat. No. 10-2836 . $3.10
Vinyl pouch case.

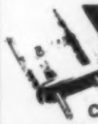
1. Drop-resistant, hand-size V-O-M with high-impact thermoplastic case.
2. 20,000 Ohms per volt DC and 5,000 Ohms per volt AC; diode overload protection with fused Rx1 Ohms range.
3. Single range switch; direct reading AC Amp range to facilitate clamp-on AC Ammeter usage.

RANGES

DC Volts: 0-3-12-60-300,1,200 (20,000 Ohms per Volt).
AC Volts: 0-3-12-60-300-1,200 (5,000 Ohms per Volt).
Ohms: 0-20k-200k-2M Ω-20M Ω (200 Ohm center scale on low range).
DC Microamperes: 0-600 at 250 mV.
DC Milliamperes: 0-6-60-600 at 250 mV.
Accuracy: ± 3% DC; ± 4% AC; (full scale).
Scale Length: 2-1/8".
Meter: Self-shielded; diode overload protected; spring backed jewels.
Case: Molded, black, high impact thermoplastic with slide latch cover for access to batteries and fuse, 2-3/4" w x 1-5/16" d x 4-1/4" h.
Batteries: NEDA 15V 220 (1), 1½V 910F (1): Complete with 42" leads, alligator clips, batteries and instruction manual. Shpg. Wt. 2 lbs.

Model 310 Cat. No. 3018 .... $53.00

BOMAR Crystal Company



Novice Crystals (Specify Band Only)

TWO METERS
CRYSTALS IN STOCK

Motorola HT 220 Crystals
In Stock!

Standard • Icom • Heathkit • Ken • Clegg • Regency • Wilson • VHF Eng • Drake • And Others!

$4.50 @ Lifetime Guarantee

Make/Model	Xmit Freq.	Rec. Freq.

ALL BAND PREAMPLIFIERS

AMECO

- 6 THRU 160 METERS
- TWO MODELS AVAILABLE
- RECOMMENDED FOR RECEIVER USE ONLY
- INCLUDES POWER SUPPLY

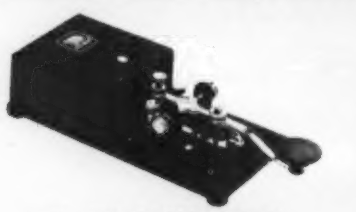
MODEL PLF employs a dual gate FET providing noise figures of 1.5 to 3.4 db., depending upon the band. The weak signal performance of most receivers as well as image and spurious rejection are greatly improved. Overall gain is in excess of 20 db. Panel contains switching that transfers the antenna directly to the receiver or to the Preamp.

Model PLF 117V AC, 60 Hz. Wired & Tested $44.00

MODEL PCLP is identical in all respects to the PLF except that two nuvistors are used instead of the FET.

Model PCLP 117V AC, 60 Hz. Wired & tested $44.00

NYE VIKING CODE PRACTICE SET



No. 114-404-002 $18.50

Get the RIGHT START!

With a NYE VIKING Code Practice Set you get a sure, smooth, Speed-X model 310-001 transmitting key, a linear circuit oscillator and amplifier, with a built-in 2" speaker, all mounted on a heavy duty aluminum base with non-skid feet. Operates on standard 9V transistor type battery (not included). Units can be connected in parallel so that two or more operators can practice sending and receiving to each other. List price, $18.50.

MOR-GAIN

Fully Air Tested — Thousands Already in Use

#16 40% Copper Weld wire annealed so it handles like soft Copper wire — Rated for better than full legal power AM/CW or SSB-Coaxial or Balanced 50 to 75 ohm feedline — VSWR under 1.5 to 1 at most heights — Stainless Steel hardware — Drop Proof Insulators — Terrific Performance — No coils or traps to break down or change under weather conditions — Completely Assembled ready to put up — Guaranteed 1 year — ONE DESIGN DOES IT ALL.

EXCLUSIVE 66 FOOT, 75 THRU 10 METER DIPOLES

NOTES

1. Models prefaced ' ** ' will be available 1/77.
2. All models above are furnished with crimp/solder lugs.
3. All models can be furnished with a SO-239 female coaxial connector at additional cost. The SO-239 mates with the standard PL-259 male coaxial cable connector. To order this factory installed option, add the letter 'A' after the model number. Example: 40-20 HD/A.
4. 75 meter models are factory tuned to resonate at 3950 kHz. (SP) models are factory tuned to resonate at 3800 kHz. 80 meter models are factory tuned to resonate at 3650 kHz. See VSWR curves for other resonance data.

MODEL	BANDS (Meters)	PRICE	WEIGHT (Oz/Kg)	LENGTH (Ft/Mtrs)
40-20 HD	40/20	$49.50	26/.73	36/10.9
**40-10 HD	40/20/15/10	59.50	36/1.01	36/10.9
80-40 HD	80/40 + 15	57.50	41/1.15	69/21.0
75-40 HD	75/40	56.00	40/1.12	66/20.1
75-40 HD (SP)	75/40	57.50	40/1.12	66/20.1
75-20 HD	75/40/20	66.50	44/1.23	66/20.1
75-20 HD (SP)	75/40/20	66.50	44/1.23	66/20.1
75-10 HD	75/40/20/15/10	74.50	48/1.34	66/20.1
75-10 HD (SP)	75/40/20/15/10	74.50	48/1.34	66/20.1
**80-10 HD	80/40/20/15/10	76.50	50/1.40	69/21.0

NO TRAPS—NO COILS— NO STUBS—NO CAPACITORS

MOR-GAIN HD DIPOLES ... • One half the length of conventional half-wave dipoles. • Multi-band, Multi-frequency. • Maximum efficiency — no traps, loading coils, or stubs. • Fully assembled and pre-tuned — no measuring, no cutting. • All weather rated — 1 KW AM, 2.5 KW CW or PEP SSB. • Proven performance — more than 15,000 have been delivered. • Permit use of the full capabilities of today's 5-band xcvrs. • One feedline for operation on all bands. • Lowest cost/benefit antenna on the market today. • Fast QSY — no feedline switching. • Highest performance for the Novice as well as the Extra-Class Op.

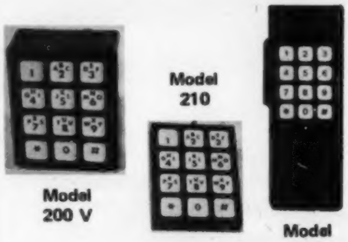
SST T-1 RANDOM WIRE ANTENNA TUNER

All band operation (160-10 meters) with most any random length wire. 200 Watt power capability. Ideal for portable or home operation. A must for Field Day. Size: 2 x 4-1/4 x 2-3/8. Built-in neon tune-up indicator. Guaranteed for 90 days. Compact — easy to use. Only $29.95.

ASTATIC MICROPHONES

SILVER EAGLE — $69.95

T-UG8-D104, transistorized	$48.60
T-UG9-D104, "Golden Eagle," transistorized	$95.40
T-UG9-D104, "Silver Eagle," transistorized	$69.95
UG-D104, ceramic or crystal	$42.60



Model 200 V

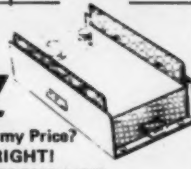
Model 210

Model 220

CES Touch Tone Pads

- ● Model 200V — acoustic coupling. $59.95
- ● Model 210 — for mounting on walkies or hand-helds. $54.95
- ● Model 220 — CES can now offer you a TOUCH TONE back for Standard Communications hand-held radios. This is the complete back assembly with the TOUCH TONE encoder mounted and ready to plug into the private channel connector. Also included is a LED tone generator indicator and an external tone deviation adjustment. $74.95.

talk power by TPL



TPL for an Economy Price? THAT'S RIGHT!

introducing the ECONO-LINE

Model	Input	Output	Typical	Frequency	Price
702	5-20W	50-90W	10 in/70 out	143-149 MHz	$139.00
702B	1-4W	60-80W	1 in/70 out	143-149 MHz	$169.00

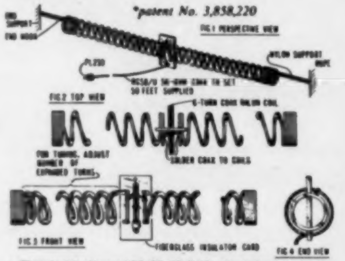
Now get TPL COMMUNICATIONS quality and reliability at an economy price. The new Econo-Line gives you everything that you've come to expect from TPL at a real cost reduction. The latest mechanical and electronic construction techniques combine to make the Econo-Line your best amplifier value. Unique broad-band circuitry requires no tuning throughout the entire 2-meter band and adjacent MARS channels. See these great new additions to the TPL COMMUNICATIONS product line at your favorite amateur radio dealer.

For prices and specifications please write for our Amateur Products Summary! FCC type accepted power amplifiers also available. Please call or write for a copy of TPL's Commercial Products Summary.

SLINKY! $43.95 Kit

A LOT of antenna in a LITTLE space New Slinky® dipole* with helical loading radiates a good signal at 1/10 wavelength long!

*patent No. 3,858,220



• This electrically small 80/75, 40, & 20 meter antenna operates at any length from 24 to 70 feet • no extra balun or transmatch needed • portable—erects & stores in minutes • small enough to fit in attic or apartment • full legal power • low SWR over complete 80/75, 40, & 20 meter bands • much lower atmospheric noise pickup than a vertical and needs no radials • kit includes a pair of specially-made 4-inch dia. by 4-inch long coils, containing 335 feet of radiating conductor, balun, 50 ft. RG58/U coax, PL259 connector, nylon rope & instruction manual • now in use by US Dept. of State, US Army, radio schools, plus thousands of hams the world over.

FT-101E TRANSCEIVER

YAESU

FT 301	160M-10M Transceiver — 200 WPEP	$769
FP 301 DIG	160M-10M Transceiver — 200 WPEP	935
FP 301	AC Power Supply	125
FP 301 CID	AC P.S. w/Clock and CW ID	209
FRG-7	General Cov. Synthesized Receiver	299
QTR-24	Yaesu World Clock	30
FT-101-E		
160-10M	XCVR W/Processor	729
FT-101EE		
160-10M	XCVR W/O Processor	649
FT-101EX		
160-10M	XCVR W/O Processor AC Only, Less Mike	589
FL-2100B	Linear Amplifier	399
FTV-650B	6M Transverter	199
FTV-250	2M Transverter	199
FV-101B	External VFO	109
SP-101B	Speaker	22
SP-101PB	Speaker/Patch	59
YO-100	Monitor Scope	199
YD-844	Dynamic Base Mike	29
FA-9	Cooling Fan	15
MMB-1	Mobile Mount	19
RFP-102	RF Speech Processor	79
XF-30C	600 Hz CW Filter	40
FR-101S		
SOLID STATE	160-2M/SW RCVR	489
FR 101 DIG		
SOLID STATE	160-2M/SW RCVR	599
FT 301S	160-10M 40WPEP	559
FT 301S	160-10M 40WPEP Digital	765
Accessories:		
FC-6	6M Converter	24
FC-2	2M Converter	25
FM-1	FM Detector	20
-	Aux/SW Crystals	5
XF-30B	AM-Wide Filter	40
XF-30C	600 Hz CW Filter	40
XF-30D	FM Filter	49
SP-101B	Speaker	22
FL-101		
SOLID STATE	160-10M	
TRANSMITTER		525
Accessories:		
RFP-101	RF Speech Processor	79
MONITOR/TEST EQUIPMENT		
YC 500 J	500 MHz (10 PPM) Counter	249
YC 500 S	500 MHz (1 PPM) Counter	365
YC 500 E	500 MHz (0.02 PPM) Counter	489
YO-100	Monitor Scope	199
YP-150	Dummy Load/Watt Meter	69
YC-601	Digital Readout (101/401 series)	169
VHF FM & SSB TRANSCEIVERS		
FT-620B	6M AM/CW/SSB	365
FT-221	2M AM/FM/CW/SSB	629
Accessories:		
MMB-4	Mobile Mount (FT-620B, FT-221)	19

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TUFTS RADIO CATALOG TUFTS RADIO

HAM RADIO / MOBILE COMMUNICATIONS

THOMSON-CSF
NPC
ELECTRONICS

MODEL	NET PRICE		
12V4	$19.95	103R	$39.95
600	$20.50	*13 HM 4	$41.95
102	$24.95	104R	$49.95
612	$27.95	12/115	$69.95
107	$28.95	108RA	$79.95
12 HM 4	$29.95	108RM	$99.95
		109R	$149.95

MODEL 12HM4

NPC 2.5 Amp Regulated Power Supply. Solid State. Short Circuit Protected.

ALSO! Available as 13 HM 4 with built-in loudspeaker.

Low cost regulated power supply quietly converts 115 volts AC to 13.5 volts DC ±200 millivolts. 1.5 amps continuous. 2.5 amps reg. Ideally suited for operating mobile CB transceivers in your home or office base station.

	TYPICAL	MAXIMUM
Output Voltage	13.5 ±.5VDC	14VDC
Continuous Current	1.5 Amp	
Regulation	2.5 Amp	
Ripple/Noise	5 mV RMS	10 mV RMS

Case: 3" (H) x 4" (W) x 5¼" (D). Shipping Weight: 3 lbs.

THOMSON-CSF
NPC
ELECTRONICS
POWER SUPPLY
REGULATED
ON
MODEL 12CB4
FOR C B
TRANSCEIVER
OFF
115 VAC/13.6 VDC 2.5 AMP REG
OVERLOAD PROTECTED
MADE IN U.S.A.

MODEL 107

NPC 4 Amp Power Supply, 6 Amp Max. Solid State. Overload Protected

NPC
POWER SUPPLY
SOLID STATE

Functions silently in converting 115 volts AC to 12 volts DC. 4 amps continuous, 6 amps max. Enables anyone to enjoy CB radio, car 8-track cartridge, cassette player or car radio in a home or office.

Continuous Current (Full Load)	4 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	10,000 uF
Ripple (Full Load)	.5 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4¾" (W) x 5¾" (D). Shipping Weight: 5 lbs.

MODEL 103R

NPC
POWER SUPPLY
REGULATED

NPC 4 Amp Regulated Power Supply. Solid State. Dual Overload Protection.

Converts 115 volts AC to 13.6 volts DC ±200 millivolts. Handles 2.5 amps continuous and 4 amps max. Ideally suited for applications where no hum and DC stability are important such as CB transmission, small Ham radio transmitter, and high quality eight-track car stereos. Can also be used to trickle-charge 12 volt car batteries.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2 VDC	13.6 ±.3 VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	2.5 Amp	
Current Limit	4 Amp	
Current Foldback	1 Amp	

Case: 3" (H) x 4¾" (W) x 5¾" (D). Shipping Weight: 4 lbs.

DC VOLT
NPC
POWER SUPPLY
REGULATED
MODEL 109R
13.6 VDC
25 AMP REG
DC AMP
OUTPUT
POWER
ON
OFF
FULLY PROTECTED
SHORT CIRCUIT
OVER TEMPERATURE
OVER VOLTAGE
OVER CURRENT
+
−

MODEL 109R

NPC 25 Amp Regulated Power Supply. 4-Way Protected. Output Voltage and Current Meters.

Extra heavy-duty unit quietly converts 115 volts AC to 13.6 volts DC ±200 millivolts. 10 amps continuous, 25 amps max. All solid state. Features dual current overload, overvoltage and thermal protection. Ideally suited for operating mobile Ham radio and linear amplifier in your home or office. Excellent bench power supply for testing and servicing of mobile communications equipment.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2VDC	13.6 ±.3VDC
Line/Load Regulation	60 mV	100 mV
Ripple Noise	5 mV RMS	10 mV RMS
Transient Response	20 uSec	
Current Continuous	10 Amp	
Current Limit	26 Amp	
Overvoltage Protection	14.5 V	15 V
Thermal Overload	180°F	

Case: 4¾" (H) x 9" (W) x 8½" (D). Shipping Weight: 15 lbs.

MODEL 12V4

NPC 1.75 Amp Power Supply. 3 Amp Max.

NPC
MODEL 12V4
POWER SUPPLY
ON

Functions silently in converting 115 volts AC to 12 volts DC. Ideally suited for most applications including 8-track stereo, burglar alarm, car radio and cassette tape player within power rating.

Continuous Current (Full Load)	1.75 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	5,000 uF
Ripple (Full Load)	.4 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4" (W) x 5¼" (D). Shipping Weight: 3 lbs.

MODEL 108RM

NPC 12 Amp Regulated Power Supply. Solid State. 3-Way Protected. Current Meter.

DC AMP
POWER SUPPLY
REGULATED

This heavy duty unit quietly converts 115 volts AC to 13.6 volts DC ±200 millivolts. 8 amps continuous, 12 amps max. All solid state. Features dual current overload and overvoltage protection. Ideally suited for operating mobile Ham radio 2 meter AM-FM-SSB transceivers in your home or office. Can also be used to trickle-charge 12 volt car batteries.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2VDC	13.6 ±.3VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	8 Amp	
Current Limit	12 Amp	
Current Foldback	2.5 Amp	
Overvoltage Protection	14.5 V	15 V

Case: 4½" (H) x 7½" (W) x 5½" (D). Shipping Weight: 9.5 lbs.

ALSO AVAILABLE AS MODEL 108RA WITHOUT METER AND OVERVOLTAGE PROTECTION.

NPC
POWER SUPPLY
REGULATED

MODEL 104R

NPC 6 Amp Power Supply Regulated. Solid State. Dual Overload Protection.

Converts 115 volts AC to 13.6 volts DC ±200 millivolts. Handles 4 amps continuous and 6 amps max. Ideally suited for applications where excellent DC stability is important, such as CB transmission, small Ham radio transmitter, and high quality eight-track car stereos. Can be used to trickle-charge 12 volt car batteries.

	MAXIMUM	TYPICAL
Output Voltage	13.6 ±.2 VDC	13.6 ±.3 VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	4 Amp	
Current Limit	6 Amp	
Current Foldback	2 Amp	

Case: 3½" (H) x 8¼" (W) x 8½" (D). Shipping Weight: 6 lbs.

NPC
POWER SUPPLY
SOLID STATE

MODEL 102

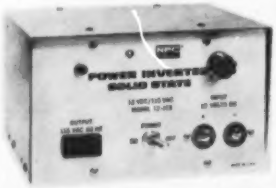
NPC 2.5 Amp Power Supply. 4 Amp Max. Solid State. Overload Protected.

Functions silently in converting 115 volts AC to 12 volts DC. 2.5 amps continuous, 4 amps max. Enables anyone to enjoy CB radio, car 8-track cartridge, cassette tape player or car radio in a home or office.

Continuous Current (Full Load)	2.5 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	5,000 uF
Ripple (Full Load)	.6 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4¾" (W) x 5¾" (D). Shipping Weight: 4 lbs.

MARINE & RV



	12 VDC IN		14 VDC IN
Output Voltage (No Load)	115 V RMS		130 V RMS
Output Voltage (Full Load)	100 V RMS		115 V RMS
Frequency (No Load)	58 Hz		66 Hz
Frequency (Full Load)	54 Hz		62 Hz
Power Continuous		200W	
Power Peak		240W	
Parallel Connection		350W	

All Values Are Typical

MODEL 12-115

NPC 12-115 Solid State Inverter. 200 W. Parallel Connection for Higher Power up to 350 W.

Converts 12 volts DC to 115 volts AC @ 60 Hz output. 200 watts continuous operation with peak power up to 240 watts. All silicon semiconductors assure high reliabiltiy at excessive ambient temperatures. The output voltage is a square wave. The inverter is not recommended where high transients are not tolerable.

The 12-115 allows you to have AC house current in your boat, car, truck, camper, house trailer, or houseboat. Will operate small household appliances, T.V., hand tools, electric shaver, AC radios, and lights within power rating. Built-in overload protection.

Case: 4½" (H) x 7½" (W) x 5½" (D). Shipping Weight: 7 lbs.

MODEL 612

Model 612 Power Converter

NPC 612 converts 6 volt negative ground or 12 volt positive ground electrical systems to 12 volt negative ground operation. Provides full 3 amp continuous power. The inexpensive solution for installing car radios, stereo and cassette tape players, in vehicles with 6 volt negative ground or 12 volt positive ground systems.

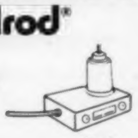
Case: 2¾" (H) x 3" (W) x 5" (D).
Shipping Weight: 1 lb.

NPC
POWER INVERTER
NPC 6/12 INVERTER
MODEL 612

● Handle full 200 watts ● low-low V.S.W.R. ● Deliver 3 dB gain and more! ● Pick the one that best fits your needs:

Larsen Külrod® Antennas

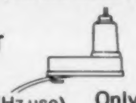
MAGNETIC MOUNT



stays put even at
100 mph!

MM-JM-150 for 144 MHz use MM-JM-220 for 220 MHz use MM-JM-440 for 440 MHz use	Only **$38.50** complete

TRUNK LID MOUNT

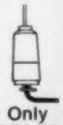


No holes and low
silhouette too!

TLM-JM-150 for 144 MHz use TLM-JM-220 for 220 MHz use TLM-JM-440 for 440 MHz use	Only **$38.50** complete

And 1/4 wave antenna for trunk and magnetic mount — $18.50

ROOF or FENDER MOUNT



Goes on quick and easy
in 3/8" or 3/4" with
fewest parts.

JM-150-K for 144 MHz use JM-220-K for 220 MHz use JM-440-K for 440 MHz use	Only **$31.50** complete

And 1/4 wave antenna for roof and fender mounts $11.50

Above antennas all complete with mounting hardware, coax, connector plug, allen wrench and complete instructions.

Model 372 — $27.50

model 372 CLIPREAMP

Get maximum legal modulation without danger of splatter. Solid-state speech preamplifier and clipper for transmitters, public-address systems, and tape recorders needs no external power.

specifications

Input Impedance	100,000 ohms
Input Levels	5 millivolts to 20 millivolts
Voltage Gain	10 dB
Output Level	60 millivolts
Output Impedance	50,000 ohms
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	2-3/4" x 3" x 4-1/2"
Shipping Weight	7 oz.
Connectors	Terminal strip

COAXIAL ANTENNA CHANGEOVER RELAY

model 377

Model 377 — $17.95

Economical and reliable. Can be operated from VOX circuit for completely automatic operation or from PTT or manual T/R switch. Receiver input is automatically grounded when the relay is in the Transmit position. Wide AC operating voltage range and low operating current.

specifications

Power Rating	1000 watts CW (2000 watts SSB)
VSWR	Less than 1.15:1, DC to 150 MHz
Power Requirements	0.015 Ampere, 40 to 120 volts AC
Connectors	UHF Type SO-239
Dimensions	3-1/2" x 1-1/2"
Shipping Weight	1 lb.

UNIVERSAL HYBRID COUPLER II PHONE PATCH

model 3002W and model 3001W

Connect your station to the telephone lines. Five switch-selectable modes give complete flexibility for patching the station to the line and for tape recording and playback to or from the line or the station. The hybrid circuit provides for effortless VOX operation of the phone patch. A built-in *Compreamp* speech preamplifier/limiter (in Model 3002W) increases the level of weak phone signals and also prevents overmodulation when the local telephone is used as the station microphone. (The *Compreamp* also functions as a preamplifier/limiter with the station microphone, if desired.)

Model 300 2W with *Compreamp* — $125.00

Model 300 1W without *Compreamp* — $85.00

specifications

Inputs from:	
Line	600 ohms
Receiver	4 ohms
Microphone	High impedance (50,000 ohms) crystal or dynamic
Tape Recorder	4 ohms
Outputs to:	
Transmitter	50,000 ohms
Receiver Speaker	4 ohms
Tape Recorder	0.5 megohm
Size	6-1/2" x 7-1/2" x 3"
Shipping Weight	3-1/2 lbs.
Power	9-volt battery, Burgess 2U6 or equivalent
Connectors	Phone

B&W

BARKER & WILLIAMSON, INC.

Model 359 — $37.50

Increase your transmitter's effective speech power up to four times. Or use it with your tape recorder or public address system for improved performance. This two-stage, transistorized Audio Preamplifier/Limiter can be used with all types of transmitters. Powered by a long-lasting dry-cell battery—no external power needed. Installs without any wiring changes in your transmitter. Just connect the Compreamp between your microphone (50,000-ohm dynamic or high-impedance ceramic) and your transmitter's microphone input connector. Front-panel rocker switch lets you bypass the *Compreamp* when you want to. Compression level is adjustable, too.

specifications

Input Impedance	100,000 ohms
Input Level	5 millivolts to 20 millivolts
Voltage Gain	10 dB
Output Level	60 millivolts
Output Impedance	50,000 ohms
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	2-3/4" x 3" x 4-1/2"
Shipping Weight	6-1/2 oz.
Connectors	Terminal strip

COAXIAL SWITCHES AND ACCESSORIES

for antenna selection and RF switching

These high-quality switches have set the standard for the industry for years. Ceramic switches with silver-alloy contacts and silver-plated conductors give unmatched performance and reliability from audio frequencies to 150 MHz.

B&W coaxial switches are designed for use with 52- to 75-ohm non-reactive loads, and are power rated at 1000 watts AM, 2000 watts SSB Connectors are UHF type. Insertion loss is negligible, and VSWR is less than 1.2:1 up to 150 MHz.

Crosstalk (measured at 30 MHz) is -45 dB between adjacent outlets and -60 dB between alternate outlets.

Models are available for desk, wall, or panel mounting, and with or without protective grounding of inactive outputs. Radial (side-mounted) connector models can be either wall or panel mounted, axial (backplate-mounted) connector models are for panel mounting only, save panel space.

Use the selector chart below to choose the models you need.

Model 550A

Model 590

Model 590G

Model 551A

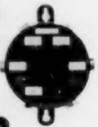
Model 592

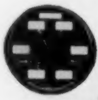
Model 595

COAXIAL SWITCH SELECTOR CHART

Model	PRICE	Outputs	Connector Placement	Mounting			Automatic Grounding	Dial Plate	Remarks
				Panel	Wall	Desk			
375	18.95	6	Axial	x			x	Supplied	PROTAX switch. Grounds all except selected output circuit.
376	18.95	5	Radial	x	x		x	Supplied	PROTAX switch. Grounds all except selected output circuit. Sixth switch position grounds *all* outputs.
550A	14.00	5	Radial	x	x			DP-5	
550A-2	12.50	2	Radial	x	x			DP-2	
551A	17.50	2	Radial	x	x			DP-2	Special 2-pole, 2-position switch used to switch any RF device in or out of series connection in a coaxial line. See figure (over).
556	.95	–	–		x			–	Bracket only, for wall mounting of radial connector switches.
590	17.95	5	Axial	x				DP-5	
590G	17.95	5	Axial	x			x	Supplied	Grounds all except selected output circuit.
592	16.50	2	Axial	x				DP-2	
595	18.50	6	In-line		x	x	x		Grounds all except selected output circuit.

Model 376





Model 375

Model 550A-2

There is no substitute for quality, performance, or the satisfaction of owning the very best.

Hence, the incomparable Hy-Gain 3750 Amateur transceiver. The 3750 covers all amateur bands 1.8-30 MHz (160-10 meters). It utilizes advanced Phase-Lock-Loop circuitry with dual gate MOS FET's at all critical RF amplifier and mixer stages. There's a rotating dial for easy band-scanning and an electronic frequency counter with digital readout and a memory display that remembers frequencies at the flip of a switch. And that's just the beginning.

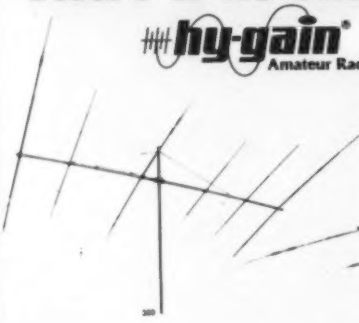
Matching speaker unit (3854) and complete external VFO (3855) also available.

See the incomparable Hy-Gain 3750 at your radio dealer or write Department MM. There is no substitute.

3854 – $59.95 3750 – $1895.00 3855 – $495.00

There is no substitute.

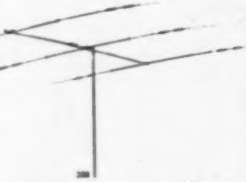
hy-gain®
Amateur Radio Systems.



Super
3-Element Thunderbird
for 10, 15 and 20 Meters
Model TH3Mk3 — $199.95

Hy-Gain's Super 3-element Thunderbird delivers outstanding performance on 10, 15 and 20 meters. The TH3Mk3 features separate and matched Hy-Q traps for each band, and feeds with 52 ohm coax. Hy-Gain Beta Match presents tapered impedance for most efficient 3 band matching, and provides DC ground to eliminate precipitation static. The TH3Mk3 delivers maximum F/B ratio, and SWR less than 1.5:1 at resonance on all bands. Its mechanically superior construction features taper swaged slotted tubing for easy adjustment and larger diameter. Comes equipped with heavy tiltable boom-to-mast clamp. Hy-Gain ferrite balun BN-86 is recommended for use with the TH3Mk3.

Electrical	TH6DXX	TH3Mk3
Gain—average	8.7dB	8dB
Front-to-back ratio	25dB	25dB
SWR (at resonance)	Less than 1.5:1	Less than 1.5:1
Impedance	50 ohms	50 ohms
Power rating	Max legal	Max legal
Mechanical		
Longest element	31.1'	27'
Boom length	24'	14'
Turning radius	20'	15.7'
Wind load at 80 MPH	156 lbs.	103.2 lbs.
Maximum wind survival	100 MPH	100 MPH
Net weight	57 lbs.	36 lbs.
Mast diameter accepted	1¼" to 2½"	1¼" to 2½"
Surface area	6.1 sq. ft.	4.03 sq. ft.



6-Element Super Thunderbird DX for 10, 15 and 20 Meters Model TH6 DXX $249.95 Separate HY-Q traps, featuring large diameter coils that develop an exceptionally favorable L/C ratio and very high Q, provide peak performance on each band whether working phone or CW. Exclusive Hy-Gain beta match, factory pretuned, insures maximum gain and F/B ratio without compromise. The TH6DXX feeds with 52 ohm coaxial cable and delivers less than 1.5:1 SWR on all bands. Mechanically superior construction features taper swaged, slotted tubing for easy adjustment and re-adjustment, and for larger diameter and less wind loading. Full circumference compression clamps replace self-tapping sheet metal screws. Includes large diameter, heavy gauge aluminum boom, heavy cast aluminum boom-to-mast clamp, and heavy gauge machine formed element-to-boom brackets. Hy-Gain's ferrite balun BN-86 is recommended for use with the TH6DXX.

HY-GAIN'S INCOMPARABLE
HY-TOWER
FOR 80 THRU 10 METERS

Model 18HT
- Outstanding Omni-Directional Performance
- Automatic Band Switching
- Installs on 4 sq. ft. of real estate
- Completely Self-Supporting

By any standard of measurement, the Hy-Tower is unquestionably the finest multi-band vertical antenna system on the market today. Virtually indestructible, the Model 18HT features automatic band selection on 80 thru 10 meters through the use of a unique stub decoupling system which effectively isolates various sections of the antenna so that an electrical ¼ wavelength (or odd multiple of a ¼ wavelength) exists on all bands. Fed with 52 ohm coax, it takes maximum legal power ... delivers outstanding performance on all bands. With the addition of a base loading coil, it also delivers outstanding performance on 160 meters. Structurally, the Model 18HT is built to last a lifetime. Rugged hot-dipped galvanized 24 ft. tower requires no guyed supports. Top mast, which extends to a height of 50 Ft., is 6061ST6 tapers aluminum. All hardware is iridite treated to MIL specs. If you're looking for the epitome in vertical antenna systems, you'll want Hy-Tower, Shpg. Wt., 96.7 lbs. Order No. 182, Price: $279.95
NEW Special hinged base assembly on Model 18HT allows complete assembly of antenna at ground level ... permits easy raising and lowering of the antenna.

BROAD BAND DOUBLET BALUN
for 10 thru 80 meters
Model BN-86
$15.95

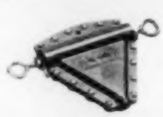
The model BN-86 balun provides optimum balance of power to both sides of any doublet and vastly improves the transfer of energy from feedline to antenna. Power capacity is 1 KW DC. Features weatherproof construction and built-in mounting brackets. $15.95 Shpg. Wt. 1 lb. Order No. 242

MULTI-BAND HY-Q TRAP DOUBLETS
Hy-Q Traps

- Install Horizontally or as Inverted V
- Super-Strength Aluminum Clad Wire
- Weatherproof Center and End Insulators

Installed horizontally or as an inverted V, Hy-Gain doublets with Hy-Q traps deliver true half wavelength performance on every design frequency. Matched traps, individually pretuned for each band feature large diameter coils that develop an exceptionally favorable L/C ratio and very high Q performance. Mechanically superior solid aluminum trap housings provide maximum protection and support to the loading coil. Fed with 52 ohm coax, Hy-Gain doublets employ super-strength aluminum clad single strand steel wire elements that defy deterioration from salt water and smoke ... will not stretch ... withstand hurricane-like winds. SWR less than 1.5:1 on all bands. Strong, lightweight, weatherproof center insulators are molded from high impact cyolac. Hardware is iridate treated to MIL specs. Heavily serrated 7-inch end insulators molded from high impact cycolac increase leakage path to approximately 12 inches.

MODEL 2BDQ for 40 and 80 meters. 100' 10½" overall. Takes maximum legal power. Shpg. Wt., 7.5 lbs $49.95
Order No. 380
MODEL 5BDQ for 10, 15, 20, 40 and 80 meters. 94' overall. Takes maximum power. Shpg. Wt., 12.2 lbs. $79.95
Order No. 383



CENTER INSULATOR for Multi-Band Doublets Model CI

Strong lightweight, weatherproof Model CI is molded from high impact cycolac. Hardware is iridite treated to MIL specs. Accepts ¼" or ¾" coaxial. Shpg. Wt., 0.6 lbs. $5.95 Order No. 155

MULTI-BAND ANTENNA
Dipole Antenna — Model DIV-80
$13.95
For 10 thru 80 meters — choice of one band

A dipole antenna for the individuals who prefer the "do-it-yourself" flexibility of custom-designing an antenna for your specific needs. (Work the frequencies you wish in the 10 through 80 meters bands).
The DIV-80 features: Durable Copperweld wire for greater strength, Mosley Dipole Connector (DPC-1) for RG-8/U or RG-58/U coax and all the technical information you will need to construct your custom-designed antenna.

END INSULATORS for Doublets Model EI

Rugged 7-inch end insulators are molded from high impact cycolac that is heavily serrated to increase leakage path to approximately 12 inches. Available in pairs only. Shpg. Wt., 0.4 lbs. $3.95 Order No. 156

- *Remote*
- *Motor Controlled*

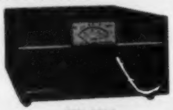
RCS-4

COAX ANTENNA SWITCH

- Control unit works on 110/220 VAC, 50/60 Hz, and supplies necessary DC to motor.
- Excellent for single coax feed to multiband quads or arrays of monobanders. The five positions allow a single coax feed to three beams and two dipoles, or other similar combinations.
- Control cable (not supplied) same as for HAM-M rotator.
- Selects antennas remotely, grounds all unused antennas. GND position grounds all antennas when leaving station. "Rain-Hat" construction shields motor and switches.
- Motor: 24 VAC, 2 amp. Lubrication good to −40°F.
- Switch RF Capability: Maximum legal limit. **Price: $120.00**

MATCHING NETWORKS

MN-4
200 watts
Price: $110.00



MN-2000
2000 watts PEP
Price: $220.00

General: • **Integral Wattmeter** reads forward power in watts and VSWR directly; can be calibrated to read reflected power • **Matches 50 ohm transmitter output** to coax antenna feedline with VSWR of at least 5:1 • Covers ham bands 80 thru 10 meters • **Switches in or out** with front panel switch • **Size:** 5½"H, 10¾"W, 8"D (14.0 x 27.3 x 20.3 cm), MN-2000, 14⅜"D (36.5 cm).
• **Continuous Duty Output:** MN-4, 200 watts; MN-2000, 1000 watts (2000 watts PEP) • **MN-2000 only:** Up to 3 antenna connectors selected by front panel switch.

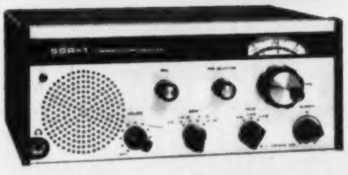
RF WATTMETERS

W-4	**1.8-54 MHz**	**Price: $ 72.00**
WV-4	**20-200 MHz**	**Price: $ 84.00**

Reads forward and reflected power directly in watts (VSWR from nomogram). Two scales in each direction. **Size:** 5½"H, 3¾"W, 4"D (14.0 x 9.5 x 10.2 cm).

Model	Full Scale	Calibration Accuracy
W-4	200 watts	(5% of reading + 2 watts)
	2000 watts	±(5% of reading + 20 watts)
WV-4	100 watts	±(5% of reading + 1 watt)
	1000 watts	±(5% of reading + 10 watts)

DRAKE



SSR-1 COMMUNICATIONS RECEIVER

- **Synthesized** • **General Coverage**
- **Low Cost** • **All Solid State** • **Built-in AC Power Supply** • **Selectable Sidebands**
- **Excellent Performance**

PRELIMINARY SPECIFICATIONS: • **Coverage:** 500 kHz to 30 MHz • **Frequency** can be read accurately to better than 5 kHz • **Sensitivity** typically .5 microvolts for 10 dB S+N/N SSB and better than 2 microvolts for 10 dB S+N/N AM • **Selectable sidebands** • **Built-in power supply:** 117/234 VAC ± 20% • **If the AC power source fails** the unit switches automatically to an internal battery pack which uses eight D-cells (not supplied) • **For reduced current drain** on DC operation the dials do not light up unless a red pushbutton on the front panel is depressed.

The performance, versatility, size and low cost of the SSR-1 make it ideal for use as a stand-by amateur or novice-amateur receiver, short wave receiver, CB monitor receiver, or general purpose laboratory receiver.

Price: $350.00

TR-4CW SIDEBAND TRANSCEIVER

GENERAL: • **All amateur bands** 10 thru 80 meters in seven 600 kHz ranges • **Solid State VFO** with 1 kHz dial divisions • **Modes** SSB Upper and Lower, CW and AM • **Built-in Sidetone** and automatic T/R switching on CW • **30 tubes and semi-conductors** • **Dimensions:** 5½"H, 10¾"W, 14⅜" D (14.0 x 27.3 x 36.5 cm). **Wt.:** 16 lbs. (7.3 kg).
TRANSMIT: • **VOX or PTT** on SSB or AM • **Input Power:** SSB, 300 watts P.E.P.; AM, 260 watts P.E.P. controlled carrier compatible with SSB linears; CW, 260 watts • **Adjustable pi-network.**
RECEIVE: • **Sensitivity** better than ½ μV for 10 dB S/N • **I.F. Selectivity** 2.1 kHz @ 6 dB, 3.6 kHz @ 60 dB. • **AGC** full on receive modes, variable with RF gain control, fast attack and slow release with noise pulse suppression • **Diode Detector** for AM reception.

Price: $649.00

34-PNB Plug-in Noise Blanker	100.00
FF-1 Crystal Control Unit	46.95
MMK-3 Mobile Mount	7.00
RV-4C Remote VFO	120.00

POWER SUPPLIES

AC-4 Power Supply	$120.00
DC-4 Power Supply	135.00

2 METER FM PORTABLE TRANSCEIVER

Model TR-33C

Amateur Net $229.95

- SCPC* Frequency Control
- 12 Channels with Selectable Xmtr Offsets.
- All FET Front-end and Crystal Filter for Superb Receiver Intermod Rejection.
- Expanded Antenna Choice.
- Low Receiver Battery Drain.
- Traditional R. L. Drake Service Backup.
- Single Crystal Per Channel.

LINEAR AMPLIFIER

Model L-4B

L-4B Linear Amplifier 895.00
• **2000 Watts PEP-SSB** • **Class B Grounded-Grid – two 3-500Z Tubes** • **Broad Band Tuned-Input** • **RF Negative Feedback** • **Transmitting AGC** • **Directional Wattmeter** • **Two Tautband Suspension Meters** • **L-4B 13-15/16" W, 7-7/8" H, 14-5/16" D. Wt.: 32 lbs.** • **Power Supply 6-3/4" W, 7-7/8" H, 11" D, Wt.: 43 lbs.**

POWER SUPPLIES

AC 4 Power Supply	$120.00
DC 4 Power Supply	135.00

Touch-n-go with

DRAKE 1525EM

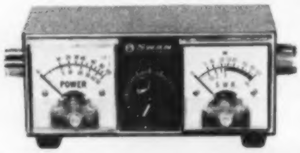
Push Button Encoding Mike

Drake 1525EM, microphone with tone encoder and connector for TR-33C, TR-22, TR-22C, ML-2 .... $49.95

- Microphone and auto-patch encoder in single convenient package with coil cord and connector. Fully wired and ready for use.
- High accuracy IC tone generator, no frequency adjustments.
- High reliability Digitran® keyboard.
- Power for tone encoder obtained from transceiver through microphone cable. No battery required. Low current drain.
- Low output impedance allows use with almost all transceivers.
- Four pin microphone plug: directly connects to Drake TR-33C without any modification in transceiver. Compatible with all previous Drake and other 2 meter units with minor modifications.
- Tone level adjustable.
- Hang-up hook supplied.

why waste watts?

(SWR-1A $25.95)



SWR-1 guards against power loss

If you're not pumping out all the power you're paying for, our little SWR-1 combination power meter and SWR bridge will tell you so. You read forward and reflected power simultaneously, up to 1000 watts RF and 1:1 to infinity VSWR at 3.5 to 150 MHz.

Got it all tuned up? Keep it that way with SWR-1. You can leave it right in your antenna circuit.

SWAN ELECTRONICS
A subsidiary of Cubic Corporation

**DELUXE
742 TRI-BAND
MOBILE
ANTENNA**

- Automatically adjusts to proper resonance for 20, 40 and 75 meters.
- Power rated at 500 Watts P.E.P.
- Includes base section, automaticoil and whip top section. 742 Antenna

Price: $109.95

**EXCLUSIVE
DELUXE
5-BAND MOBILE
45 ANTENNA**

- All band manual switching antenna for 10, 15, 20, 40 and 75 meters.
- Power rated at 1000 Watts P.E.P.
- Includes base section with mobilecoil and six foot whip top section. 45 Antenna

Price: $119.95

SWAN METERS HELP YOU GET IT ALL TOGETHER

These wattmeters tell you what's going on.

With one of these in-line wattmeters you'll know if you're getting it all together all the time. Need high accuracy? High power handling? Peak power readings? For whatever purpose we've got the wattmeter for you. Use your Swan credit card. Applications at your dealer or write to us.

Swan
WM 2000
SWR
Swan
WM 3000
Swan
WM 1500

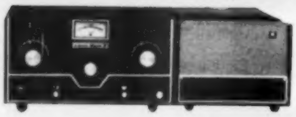
WM2000 In-Line Wattmeter With Muscle. Scales to 2000 watts. New flat-response directional coupler for maximum accuracy. $59.95

WM3000 Peak-reading Wattmeter. Reads RMS power then with the flick of a switch, true peak power of your single-sideband signal. That's what counts on SSB. $79.95

WM1500 High-Accuracy In-Line Wattmeter. 10% full scale accuracy on 5, 50, 500 and 1500 watt scales, 2 to 30 MHz. Forward and reflected power; use it for trouble-shooting, too. $74.95

SWAN ELECTRONICS
A subsidiary of Cubic Corporation

SWAN LINEAR AMPLIFIERS A Mark II 2000 watt P.E.P. full legal input power unit or the 1200X matching Cygnet 1200 watt P.E.P. input powerhouse with built-in power supply. The choice is yours. $849.95



**NEW Swan MMBX
Impedance Matcher**
It keeps your transmitter and your antenna on speaking terms for a song. Price: $23.95

**CYGNET 1200X PORTABLE
LINEAR AMPLIFIER**

To quadruple the output of the 300B Cygnet *de novo*, simply add this matching unit for more than a kilowatt of power. Complete with self-contained power supply and provision for external ALC, this Cygnet offers exceptionally high efficiency and linearity. $349.95

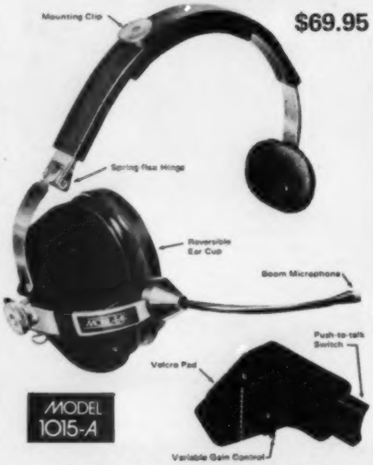
Additional Swan products include: fixed and mobile antennas, VFO's telephone patch, VOX, wattmeter, microphones and mounting kits. As another extra service, only Swan Electronics offers factory-backed financing to the amateur radio community. Visit an authorized Swan Electronics dealer for complete details

SWAN ELECTRONICS

JMR MOBIL-EAR™

Two-way-radio headset with superior fidelity Electret-Capacitor boom microphone and palm-held talk switch.

$69.95



FOR BROADCAST-QUALITY TRANSMISSION AND RECEPTION FOR BOTH MOBILE UNITS AND BASE STATIONS.

- Boom-mounted electret-capacitor microphone delivers studio-quality, undistorted voice reproduction. Variable gain control lets you adjust for optimum modulation.
- Cushioned earcup lets you monitor in privacy – no speaker blare to disturb others. Blocks out environmental noises, too. Made of unbreakable ABS plastic.
- Headband self-adjusts for comfortable wear over long hours. Spring-flex hinge lets you slip headset on and off with just one hand. Reversible for right or left ear.
- Headset can be hung on standard microphone clip.
- Compact palm-held talk switch lets you keep *both* hands on the wheel for safer driving. Made of unbreakable ABS plastic.
- Built-in FET transistor amplifier adapts microphone output to any transceiver impedance.
- Compatible with most two-way radios including 40-channel CB units.
- Built-in Velcro pad for easy mounting of the talk switch.
- Made in U.S.A.

SPECIFICATIONS

Earphone impedance and type:	8 ohms, dynamic
Microphone type:	Electret capacitor
Microphone frequency response:	200–6000 Hz
Amplifier type:	FET transistor, variable gain
Amplifier battery power:	7-volt Mallory TR-175
Switching:	Relay or electronic

IDEAL FOR EVERY TWO-WAY RADIO COMMUNICATIONS NEED . . .

CB operators • Amateur radio operators • Police and fire vehicles • Ambulances and emergency vehicles • Taxis and truckers • Marine pleasure and work boats • Construction and demolition crews • Industrial communications • Security patrols • Airport tower and ground crews • Remote broadcast and TV-camera crews • Foresters and fire-watch units •

ARGONAUT
#509

AMPLIFIER
#405

TEN-TEC

ARGONAUT, MODEL 509

Covers all Amateur bands 10-80 meters. 9 MHz crystal filter. 2.5 kHz bandwidth. 1.7 shape factor @ 6/50 dB points. Power required 12-15 VDC @ 150 mA receive, 800 mA transmit at rated output. Construction: aluminum chassis, top and front panel, molded plastic end panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 13" x 7". Weight 6 lbs.

LINEAR AMPLIFIER, MODEL 405

Covers all Amateur bands 10-80 meters. 50 watts output power, continuous sine wave. RF wattmeter. SWR meter. Power required 12-15 VDC @ 8 A, max. Construction: aluminum chassis, top and front panel, molded plastic side panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 7" x 8". Weight 2½ lbs.

Argonaut, Model 509 . . . . . $359.00
Linear Amplifier, Model 405 . 159.00
Power Supply, Model 251
(Will power both units) 79.00
Power Supply, Model 210
(Will power Argonaut only) . . 30.00

The new ultra-modern fully solid-state TRITON makes operating easier and a lot more fun, without the limitations of vacuum tubes.

For one thing, you can change bands with the flick of a switch and no danger of off-resonance damage. And no deterioration of performance with age.

But that's not all. A superlative 8-pole i-f filter and less than 2% audio distortion, transmitting and receiving, makes it the smoothest and cleanest signal on the air.

The TRITON IV specifications are impeccable. For selectivity, stability and receiver sensitivity. And it has features such as *full* CW break-in, pre-selectable ALC, off-set tuning, separate AC power supply, 12 VDC operation, perfectly shaped CW wave form, built-in SWR bridge and on and on.

For new standards of SSB and CW communication, write for full details or talk it over with your TEN-TEC dealer. We'd like to tell you why "They Don't Make 'Em Like They Used To" makes Ham Radio even more fun.

TRITON IV $699.00

ACCESSORIES:

Model 240 One-Sixty Converter	$ 97.00
Model 244 Digital Readout	197.00
Model 245 CW Filter	$ 25.00
Model 249 Noise Blanker	29.00
Model 252G Power Supply	99.00
Model 262G Power Supply/VOX	129.00

TEN-TEC

KR20-A ELECTRONIC KEYER

A fine instrument for all-around high performance electronic keying. Paddle actuation force is factory adjusted for rythmic smooth keying. Contact adjustments on front. Weighting factor factory set for optimum smoothness and articulation. Over-ride "straight key" conveniently located for emphasis, QRS sending or tune-up. Reed relay output. Side-tone generator with adjustable level. Self-completing characters. Plug-in circuit board. For 117 VAC, 50-60 Hz or 6-14 VDC. Finished in cream and walnut vinyl. Price $57.50

KR5-A ELECTRONIC KEYER

Similar to KR20-A but without side-tone oscillator or AC power supply. Ideal for portable, mobile or fixed station. A great value that will give years of troublefree service. Housed in an attractive case with cream front, walnut vinyl top. For 6-14 VDC operation. Price $38.50

KR1-A DELUXE DUAL PADDLE

Paddle assembly is that used in the KR50, housed in an attractive formed aluminum case. Price $35.00

KR2-A SINGLE LEVER PADDLE

For keying conventional "TO" or discrete character keyers, as used in the KR20-A. Price $15.00

KR50 ELECTRONIC KEYER

A completely automatic electronic keyer fully adjustable to your operating style and preference, speed, touch and weithting, the ratio of the length of dits and dahs to the space between them. Self-controlled keyer to transmit your thoughts clearly, articulately and almost effortless. The jambie (squeeze) feature allows the insertion of dits and dahs with perfect timing.

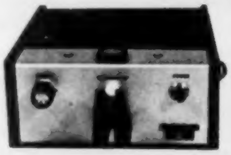
An automatic weighting system provides increased character to space ratio at slower speeds, decreasing as the speed is increased, keeping the balance between smoothness at low speeds and easy to copy higher speed. High intelligibility and rythmic transmission is maintained at all speeds, automatically.

Memories provided for both dits and dahs but either may be defeated by switches on the rear panel. Thus, the KR50 may be operated as a full iambic (squeeze) keyer, with a single memory or as a conventional type keyer. All characters are self-completing. Price $110.00

SPECIFICATIONS

Speed Range: 6-50 w.p.m.
Weighting Ratio Range: 50% to 150% of classical dit length.
Memories: Dit and dah. Individual defeat switches.
Paddle Actuation Force: 5-50 gms.
Power Source: 117VAC, 50-60 Hz, 6-14 VDC.
Finish: Cream front, walnut vinyl top and side panel trim.
Output: Reed relay. Contact rating 15 VA, 400 V. max.
Paddles: Torque drive with ball bearing pivot.
Side-tone: 500 Hz tone.
Adjustable output to 1 volt.
Size HWD: 2½" x 5½" x 8¼"
Weight: 1¾ lbs.

TEN-TEC



KR50

NORTH SHORE
RF TECHNOLOGY

DUPLEXER & CAVITY KITS...

NOW AVAILABLE FOR YOU
FULLY ASSEMBLED & TUNED!

- UPGRADE YOUR REPEATER WITH AN RF TECHNOLOGY DUPLEXER.
- ALL DUPLEXERS AND CAVITIES ARE TEMPERATURE COMPENSATED WITH INVAR® AND MEET ALL COMMERCIAL STANDARDS
- ONLY TOP QUALITY MATERIALS GO INTO OUR PRODUCTS.
- BOTH KITS & ASSEMBLED DUPLEXERS AND CAVITIES ARE AVAILABLE TO YOU AT A SAVINGS TO YOU.

Mod. 62-3 . . . 6 cav., 2 mtr., insertion loss 0.6 db with isolation 100 db typical; pwr. 350 w. Kit $399 ea. — Assembled $499.

Mod. 4220-3 . . . 4 cav. 220 MHz insertion loss 0.6 db with 80 db isolation typical; pwr. 350 w. Kit $279 ea. — Assembled $349.

Mod. 4440-3 . . . 4 cav. 440 MHz, insertion loss 0.6 db with 80 db isolation loss 0.6 db with 80 db isolation typical; pwr. 350 w. Kits $249 ea. — Assembled $329.

Mod. 30 Cavity Kits: 2 mtr. $75 ea., 220 MHz $65 ea., 440 MHz $65 ea.; 6 mtr. $115 ea. Add $15 for Assembled Kit.

Also available: 6 mtr., 4 cav. Kit $399 — Assembled $499, 2 mtr. 4 cav. Kit $299 — Assembled $399, 440 MHz TV Repeater Duplexer.

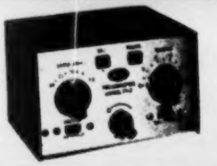
Now You Can Receive The Weak Signals With The ALL NEW AMECO PREAMPLIFIER

Model PT-2 is a continuous tuning 6-160 meter Pre-Amp specifically designed for use with a transceiver. The PT-2 combines the features of the well-known PT with new sophisticated control circuitry that permits it to be added to virtually any transceiver with No modification. No serious ham can be without one.

- Improves sensitivity and signal-to-noise ratio.
- Boosts signals up to 26 db.
- For AM or SSB.
- Bypasses itself automatically when the transceiver is transmitting.
- FET amplifier gives superior cross modulation protection.
- Advanced solid-state circuitry.
- Simple to install.
- Improves immunity to transceiver front-end overload by use of its built-in attenuator.
- Provides master power control for station equipment.

MODEL PT-2

$69.95



The indispensable BIRD model 43 THRULINE® Wattmeter

MODEL		PRICE
43		$120
Elements (Table 1) 2-30 MHz		42
Elements (Table 1) 25-1000 MHz		36
Elements (Table 2)		50
80F, 80M	5W	27
8080 QC-N (M)	25W	47
8085 QC-N (M)	50W	75
Minimonitor®		149

Read RF Watts Directly.

0.45-2300 MHz, 1-10,000 watts ±5%, Low Insertion VSWR—1.05.

Unequalled economy and flexibility: Buy only the element(s) covering your present frequency and power needs, add extra ranges later if your requirements expand.

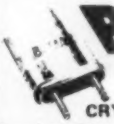
BIRD

Table 1 STANDARD ELEMENTS (CATALOG NUMBERS)

Power Range	Frequency Bands (MHz) 2-30	25-60	50-125	100-250	200-500	400-1000
5 watts	—	5A	5B	5C	5D	5E
10 watts	—	10A	10B	10C	10D	10E
25 watts	—	25A	25B	25C	25D	25E
50 watts	50H	50A	50B	50C	50D	50E
100 watts	100H	100A	100B	100C	100D	100E
250 watts	250H	250A	250B	250C	250D	250E
500 watts	500H	500A	500B	500C	500D	500E
1000 watts	1000H	1000A	1000B	1000C	1000D	1000E
2500 watts	2500H					
5000 watts	5000H					

Table 2 LOW-POWER ELEMENTS

1 watt	Cat. No.	2.5 watts	Cat. No.
60-80 MHz	060-1	60-80 MHz	060-2
80-95 MHz	080-1	80-95 MHz	080-2
95-125 MHz	095-1	95-150 MHz	095-2
110-160 MHz	110-1	150-250 MHz	150-2
150-250 MHz	150-1	200-300 MHz	200-2
200-300 MHz	200-1	250-450 MHz	250-2
275-450 MHz	275-1	400-850 MHz	400-2
425-850 MHz	425-1	800-950 MHz	800-2
800-950 MHz	800-1		



BOMAR Crystal Company

Novice Crystals (Specify Band Only)

TWO METERS

CRYSTALS IN STOCK

Motorola HT 220 Crystals In Stock!

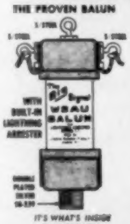
Standard ● Icom ● Heathkit ● Ken ● Clegg ● Regency ● Wilson ● VHF Eng ● Drake ● And Others!

$4.50 @ Lifetime Guarantee

Make/Model	Xmit Freq.	Rec. Freq.

THE BIG SIGNAL $12.95 "W2AU" BALUN

THE APPROVED LEADING HAM AND COMMERCIAL BALUN IN THE WORLD TODAY.


THE PROVEN BALUN
WITH BUILT-IN LIGHTNING ARRESTER
W2AU BALUN
IT'S WHAT'S INSIDE THAT COUNTS!

1. HANDLES FULL 2 KW PEP AND THEN SOME. Broad-Banded 3 to 40 Mc.
2. HELPS TVI PROBLEMS By Reducing Coax Line Radiation
3. NOW ALL STAINLESS STEEL HARDWARE. SO239 Double Silver Plated
4. IMPROVES F/B RATIO By Reducing Coax Line Pick-Up
5. REPLACES CENTER INSULATOR. Withstands Antenna Pull of Over 600 Lbs.
6. BUILT-IN LIGHTNING ARRESTER. Helps Protect Balun — Could Also Save Your Valuable Gear
7. BUILT-IN HANG-UP HOOK. Ideal For Inverted Vees, Multi-Band Antennas, Dipoles, Beam and Quads

NOW BEING USED BY ALL BRANCHES OF THE U.S. ARMED FORCES, FAA, RCA, CIA, CANADIAN DEFENSE DEPT. PLUS THOUSANDS OF HAMS THE WORLD OVER

THEY'RE BUILT TO LAST...

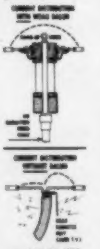
BIG SIGNALS DON'T JUST HAPPEN— GIVE YOUR ANTENNA A BREAK

Comes in 2 models. 1:1 matches 50 or 75 ohm unbalanced (coax line) to 50 or 75 ohm balanced load. 4:1 model matches 50 or 75 ohm unbalanced (coax line) to 200 or 300 ohm balanced load.

AVAILABLE AT ALL LEADING DEALERS. IF NOT, ORDER DIRECT

The big signal W2AU Balun reflects the type of quality that has kept our product out front and number 1 in Baluns the world over for the past 10 years.

The originator of the Balun with a built-in lightning arrester and hang up hook.



We'll GUARANTEE no other balun, at any price, has all these features.

SERIES 31 — BNC CONNECTORS

Amphenol's BNC connectors are small, lightweight, weatherproof connectors with bayonet action for quick disconnect applifications.

Shells, coupling rings and male contacts are accurately machined from brass. Springs are made of beryllium copper. All parts in turn are ASTROplated® to give you connectors that can take constant handling, high temperatures and resist abrasion.

BNC BULKHEAD RECEPTACLE 31-221-385 UG-1094 Mates with any BNC plug. Receptacle can be mounted into panels up to 104" thick. $1.25

BNC (M) TO UHF (F) ADAPTER 309-2900-385 UG-225 Adapts any BNC jack to any UHF plug. $3.63

DOUBLE MATE ADAPTER 83-877-385 Both coupling rings are free turning. Connects 2 female components. $2.72

JACK ADPATER $1.95

575-102-385 Adapts 83-1SP-385 to Motorola type auto antenna jack or pin jack.

PANEL RECEPTACLE 83-1R-385 SO239 Mounts with 4 fasteners in 21/32" diameter hole. $1.17

PANEL RECEPTACLE 83-878-385 SO239SH Mounts in single 21/32" diameter hole. Knurled lock nuts prevent turning. $1.59

BNC ANGLE ADAPTER 31-009-385 UG-306 Adapts any BNC plug for right angle use. $4.23

BNC TEE ADAPTER 31-008-385 UG-274 Adapts 2 BNC plugs to 31-003-385 or other female BNC type receptable. $4.56

UG-255

UG-1094

575-102-385

BNC(F) TO UHF (M) ADAPTER 31-028-385 UG-273 Adapts any BNC plug to any UHF jack. $2.39

PUSH-ON 83-1SP-385 83-5SP-385 Features an unthreaded, springy shell to push fit on female connectors. $2.27

LIGHTNING ARRESTOR 575-105-385 Eliminates static build-up from antenna. Protects your valuable equipment against lightning damage. $4.80

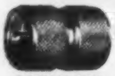
BNC PLUG 31-002-385 UG-88 Commonly used for communications antenna lead cables. For RG 55/U & RG 58/U cables. $1.59

BNC STRAIGHT ADAPTER 31-219-385 UG-914 1 9/32" long, allows length of cables to be joined. Mates with BNC plugs. $2.12

BNC PANEL RECEPTACLE 31-003-385 UG-290 Mounts with 4 fasteners in 29/64" diameter hole. $1.74

SERIES 581 — PACKAGED CABLE ASSEMBLIES

All popular lengths are now available in your choice of RG 8/U or RG 58/U type low loss polyfoam dielectric cable. Installed PL-259 connectors are ASTROplated — Amphenol's new non-tarnishing finish — which has all the advantages of precious metal plus more heat, corrosion and abrasion resistors that silver ever had! These cable assemblies are ideal for CB, ham radio and other communications antenna installations and they are ready for immediate use.



83-877-385

QUALITY CABLE PRODUCTS

SO239

UG-290

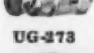
UG-274

SO239SH

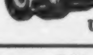
83-5SP-385

UG-306

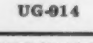
575-105-385



UG-273



UG-88



UG-914

RG 8/U TYPE POLYFOAM COAXIAL CABLE ASSEMBLIES 581-803 3-ft. with ASTROplated PL-259's on both ends. $5.60

581-820 20-fit with ASTROplated PL-259's on both ends. $11.80

581-850 50-fit with ASTROplated PL-259's on both ends. $23.10

581-875 75-fit with ASTROplated PL-259's on both ends. $30.30

581-8100 100-ft. with ASTROplated PL-259's on both ends. $38.50

RG 58/U TYPE POLYFOAM COAXIAL CABLE ASSEMBLIES 581-5812 12-ft. with ASTROplated PL-259's on both ends. $6.34

581-5820 20-ft with ASTROplated PL-259's on one end and SPADE LUGS ON OTHER END. $6.30

518-5820-2 20-ft. with ASTROplated PL-259's on both ends. $7.36

581-5850 50-ft. with ASTROplated PL-259's on both ends. $11.20

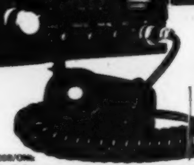
581-5875 75-ft. with ASTROplated PL-259's on both ends. $14.00

581-58100 100-ft. with ASTROplated PL-259's on both ends. $16.10

A new precision clock which tells time anywhere in the world at a glance, has been announced by **Yaesu Electronics Corporation**. The time in any principal city or time zone can be simultaneously coordinated with local time on a 24 hour basis. After the initial setting, as the clock runs, a Time Zone Hour Disc advances automatically, showing correct time all over the world without further adjustment. The clock is especially designed to withstand shock and may be hung on a wall or placed on its desk mount. The clock will run an entire year on a single 1.5 volt flashlight battery and the mechanism starts as soon as the battery is inserted. It measures six inches in diameter by two and one half inches deep. An excellent item for the business office, ham radio operator, short wave listener, boat owner, and others who want an accurate dependable clock.

Price: $30.00 Amateur net.

Now...more than ever---
the TEMPO line means solid value



Tempo VHF/ONE

the "ONE" you've been waiting for

$399.00

No need to wait any longer — this is it! Whether you are already on 2-meter and want something better or you're just thinking of getting into it, the VHF/ONE is the way to go.

• Full 2-meter band coverage (144 to 148 MHz for transmit and receive. • Full phase lock synthesized (PLL) so no channel crystals are required. • Compact and lightweight — 9.5" long x 7" wide x 2.25" high. Weight — About 4.5 lbs. • Provisions for an accessory SSB adaptor. • 5-digit LED receive frequency display. • 5 KHz frequency selection for FM operation. • Automatic repeater split — selectable up or down for normal or reverse operation. • Microphone, power cord and mounting bracket included. • Two built-in programmable channels. • All solid state. • 10 watts output. • Super selectivity with a crystal filter at the first IF and E type ceramic filter at the second IF. • 800 Selectable receive frequencies. • Accessory 9-pin socket.

TEMPO SSB/ONE

$199.00

SSB adapter for the Tempo VHF/One

" Selectable upper or lower sideband. " Plugs directly into the VHF/One with no modification. " Noise blanker built-in. " RIT and VXO for full frequency coverage. "

ATLAS 350-XL

- ALL SOLID STATE
- SSB TRANSCEIVER
- 350 WATTS P.E.P. OR CW INPUT
- 10 THROUGH 160 METER COVERAGE

Illustrated with optional AC supply, Auxiliary VFO, and Digital Dial.

The all new Atlas 350-XL has all the exciting new features you want, plus superior performance and selectivity control never before possible.

● 10-160 METERS
Full coverage of all six amateur bands in 500 kHz segments. Primary frequency control provides highly stable operation. Also included is provision for adding up to 10 additional 500 kHz segments between 2 to 22 MHz by plugging in auxiliary crystals.

● 350 WATTS
P.E.P. and CW input. Enough power to work the world barefoot!

IDEAL FOR DESKTOP OR MOBILE OPERATION
Measuring just 5 in. high x 12 in. wide x 12⅛ in. deep, and weighing only 13 pounds, the Atlas 350-XL offers more features, performance and value than any other transceiver, regardless of size, on the market today!

● SELECTIVITY CONTROL
This amazing new breakthrough in filter design is truly the filter of the future. Selectivity control on the front panel provides control of bandwidth as well as selection of upper or lower sideband, or double sideband. Continuously variable from 300 to 2700 Hz bandwidth. Shape factor is better than 1.7, with ultimate rejection better than 130 dB. Selectivity for SSB can be set for maximum voice fidelity at 2700 Hz bandwidth, providing transmission and reception of audio from 300 to 3000 Hz, or it can be narrowed down to 2400, 2100 or even 1500 Hz if necessary to reduce adjacent channel QRM. Selectivity can be narrowed gradually to as little as 300 Hz for CW reception.

This amazing new breakthrough in filter design is by Bob Crawford and Eckert Argo of Consulting Engineers. Atlas Radio is privileged to be first to offer this "programmable filter" in the radio communication field and for sometime to come will be the only one.

● RECEIVER INCREMENTAL TUNING
● AUDIO FREQUENCY NOTCH FILTER
● PUSH TO TALK
● VOX OPERATION
● FULL BREAK-IN CW OPERATION
MODEL 350-XL $995

● DIGITAL DIAL READOUT
The Atlas 350-XL has space provided for quick installation of this plug-in accessory. Provides precise frequency readout within 50 Hz. All L.E.D. Dot Matrix 6 digit display.
DD6-XL DIGITAL DIAL $195

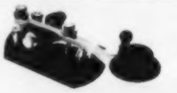
● PLUG-IN AUXILIARY VFO or CRYSTAL OSCILLATOR
Auxiliary VFO is plugged into the space provided on the front panel of the 350-XL. You have a second tuneable VFO with same tuning ranges as primary VFO for tuning to a separate transmit or receive frequency. LEDs indicate which VFO, primary or secondary, will be used for receive and transmit.

Or instead of the auxiliary VFO a Crystal Oscillator may be plugged into the front panel. Eleven crystal sockets are available with a vernier control for exact frequency setting.
MODEL 305 AUXILIARY VFO $155
MODEL 311 AUXILIARY CRYSTAL OSCILLATOR $135

● 350-PS MATCHING AC SUPPLY
Includes front facing speaker and phone jack. Provides 14 volts filtered and regulated D.C. for both low current and high current circuits of the 250-XL. Internal space provided for future installation of accessories such as CW Keyer, Speech Processor, Phone Patch, etc. Operates on 100-130 or 200-260 volts, 50-60 Hz . . $195

● SAME PLUG-IN-AND-GO MOBILE FEATURE AS OUR FAMOUS 210x/215x
The 350-XL has its own optional Mobile Mounting Bracket for quick, easy plug-in or removal from your car. All connections are made automatically $65

● ATLAS 210x/215x SSB TRANSCEIVERS
Our famous little compact SSB Transceivers remain a very important part of our product line $679
With noise blanker installed $719



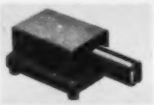
No. 114-320-003 — $9.90
No. 114-322-003 — Brass — $10.30

No. 114-320-001 — $8.30
No. 114-322-001 — Brass — $8.85

No. 114-310-003 — $8.25
No. 114-312-003 — Brass — $8.85

NYE VIKING SPEED-X KEYS
NYE VIKING Standard Speed-X keys feature smooth, adjustable bearings, heavy-duty silver contacts, and are mounted on a heavy oval die cast base with black wrinkle finish. Available with standard, or Navy knob, with, or without switch, and with nickel or brass plated key arm and hardware.

Pamper yourself with a Gold-Plated NYE VIKING KEY!
Model No. 114-31C-004GP has all the smooth action features of NYE Speed-X keys in a special "presentation" model. All hardware is heavily gold plated and it is mounted on onyx-like jet black plastic sub-base. List price is $50.00.

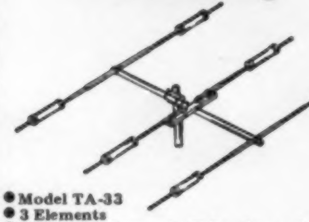


No. SSK-1 $23.95
No. SSK-1CP-Chrome — $29.95

NYE VIKING SQUEEZE KEY
Extra-long, finger-fitting molded paddles with adjustable spring tension, adjustable contact spacing. Knife-edge bearings and extra large, gold plated silver contacts! Nickel plated brass hardware and heavy, die cast base with non-skid feet. Base and dust cover black crackle finished. SSK-1 — $23.45.
SSK-1CP has heavily chrome-plated base and dust cover. List price, $29.95.

CODE PRACTICE SET
You get a sure, smooth, Speed-X model 310-001 transmitting key, linear circuit oscillator and amplifier, with a built-in 2" speaker, all mounted on a heavy duty aluminum base with non-skid feet. Operates on standard 9V transistor type battery (not included). List price, $18.50.
PHONE PATCH Model No. 250-46-1 measures 6-1/2" wide, 2-1/4" high and 2-7/8" deep. List price, $36.50. Model 250-46-3, designed for use with transceivers having a built-in speaker, has its own built-in 2" x 6" 2 watt speaker. Measures 6-1/2" wide, 2-1/4" high and 2-7/8" deep. List price, $44.50.

Mosley



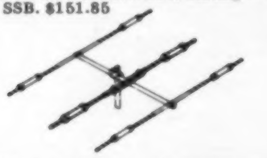
- **Model TA-33**
- **3 Elements**
- **10.1 db Forward Gain (over isotropic source)**
- **20 db Front-to-Back Ratio**

The Mosley TA-33, 3-element beam provides outstanding 10, 15 and 20 meter performance. Exceptionally broadband — gives excellent results over full Ham bandwidth. Incorporating Mosley Famous Trap-Master traps. Power Rating — 2KW P.E.P. SSB. The TA-33 may also be used on 40 meters with TA-40KR conversion. Complete with hardware. $206.50

MULTI-BAND BEAMS
TRAP MASTER 33 . . . 10, 15 & 20 Meters

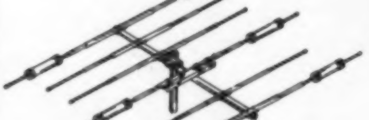
- **Model TA-33Jr.**
- **3 Elements**
- **10.1 db Forward Gain (over isotropic source)**
- **20 db Front-to-Back Ratio**

The TA-33Jr . . . incorporates Mosley Trap-Master Junior traps. This is the low power brother of the TA-33. Power Rating — 1 KW P.E.P. SSB. $151.85



TA-33JR. POWER CONVERSION KIT MODEL MPK-3

Owners of the Mosley Trap-Master TA-33Jr. may obtain higher power without buying an entirely new antenna. The addition of the MPK-3 (power conversion kit) converts the TA-33Jr. into essentially a new antenna with 750 watts AM/CW and 2000 watts P.E.P. SSB. $52.25

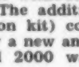


TRAP MASTER 36 . . . 10, 15 & 20 Meters

- **Model TA-36**
- **6 Elements**
- **Forward Gain (over isotropic source) - 10.1 db on 15 & 20 meters, 11.1 db on 10 meters.**

Front-to-Back Ratio on all bands. 20 db.

This wide-spaced, six element configuration employs 4 operating elements on 10 meters, 3 operating elements on 15 meters, and 3 operating elements on 20 meters. Automatic bandswitching is accomplished through Mosley exclusively designed high impedance parallel resonant "Trap Circuit." The TA-36 is designed for 1000 watts AM/CW or 2000 watts P.E.P. SSB. Traps are weather and dirt proof, offering frequency stability under all weather conditions. $335.25



MOSLEY AK-60 MAST PLATE ADAPTER

Mast Plate Adapter for adapting your Mosley 1½" mounted beam to fit 2" OD mast. Complete with angle and hardware. $11.15

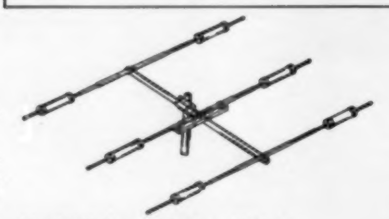
NATIONAL RADIO COMPANY, INC.
NRCI

NCL-2000

Linear Amplifier. A full 10 Db gain. 20 watts in 2000 watts out. Can be driven with one watt. Continuous duty design utilizes two 8122 ceramic tetrode output tubes, designed for both AM and SSB operation. The industry standard for 12 years. Thousands in use all over the world. Price: $1,200

NCX-1000

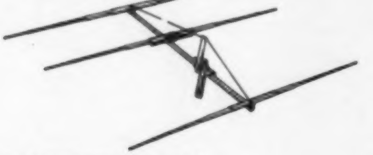
The only 1000 watt, "single package" transceiver. Heavy duty design . . . results of 50 years of design leadership in amateur equipment. State of the art speech processing. linear amplifier, power supply, all in one package. Nothing extra to buy. Covers all amateur bands in HF spectrum . . . AM, SSB, CW. Price: $1,600



CLASSIC-33 . . . 10, 15 & 20 Meters
Model CL-33

- **3 Elements**
- **10.1 db Forward Gain (over isotropic source) on all bands.**
- **20 db Front-to-Back Ratio on 15 & 20 meters, 15 db on 10 meters.**

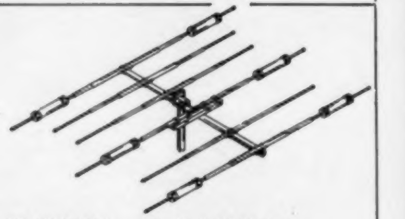
BRIDGING THE GAP . . . The Classic 33, combines the best of two Mosley systems. Incorporating Mosley Classic Feed System for a "Balanced Capacitive Matching" system with a feed point impedance of 52 ohms at resonance, and the Famous Mosley Trap-Master Traps for "weather-proof" traps with resonant frequency stability. This extra sturdy multi-band beam, Model CL-33, for operation on 10, 15 & 20 meters features improved boom to element clamping, stainless steel hardware, balanced radiation and a longer boom for even wider element spacing. Power Rating — 2 KW P.E.P. SSB. Recommended mast size — 2" OD. Wind Load — 120 lbs. at 80 MPH. Approx. shipping weight — 45 lbs. $232.50



CLASSIC-203 . . . 20 Meters
Model CL-203
3 Elements

- **10.1 db Forward Gain (over isotropic source)**
- **20 db Front-to-Back Ratio**

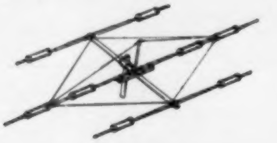
Incorporating the Mosley patented Classic Feed System, this full size 20 meter single-band beam has 1½" to 3/8" dia. "swaged" elements wide spaced on a 2" dia. 24' boom. Maximum element length-37' 8½". The high standards in quality construction established by Mosley in over a quarter-century of manufacturing is reflected in this mono-band . . . Model CL-203. Boom-to-mast clamping assures stability with a time-tested arrangement of mast plate, cast aluminum clamping blocks and stainless steel U-bolts. The exclusive "Balanced Capacitive Matching" System has a nominal feed point impedance of 52 Ohms at 2 KW P.E.P. SSB. Recommended mast size-2" O.D. Approx. shipping wt: 42 lbs. via truck. $227.65



CLASSIC-36 . . . 10, 15 & 20 Meters
Model CL-36

- **6 Elements**
- **10.1 db Forward Gain (over isotropic source) on 15 & 20 meters, 11.1 db on 10 meters.**
- **20 db Front-to-Back Ratio on all bands.**

The Classic 36, like the smaller Classic 33, incorporates both the Mosley World-Famous Trap-Master Traps and the Mosley Classic Feed-System. Designed to operate on 10, 15 & 20 meters, this multi-band beam Model CL-36, employs the high standards of quality construction found in all Mosley products. The boom-to-mast clamping assures stability with a time-tested arrangement of mast plate, cast aluminum clamping blocks and stainless steel U-bolts. The exclusive "Balanced Capacitive Matching" system has a feed point impedance of 52 ohms at resonance. Wind Load — 210.1 lbs. at 80 MPH. Power Rating — 2 KW P.E.P. SSB. Recommended mast size — 2" OD. Approx. shipping weight — 71 lbs. via truck. $310.65



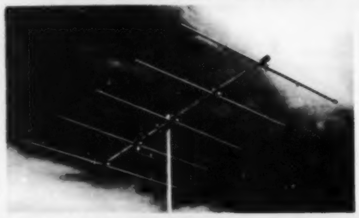
40 METER CONVERSION KIT MODEL TA-40KR

Work 40 meters in addition to 10, 15 & 20 meters by using a TA-40KR conversion kit on the radiator element of the TA-33 and TA-36. (Beams with broad band capacitive matching may not be converted!) Convert the TA-33Jr. with the MPK-3 (power conversion kit) before adding the TA-40KR kit. $92.25

SIGNAL-MASTER ANTENNA
Beam Antenna . . . Model S-402 for 40 meters

For a top signal needed to push through forty meter QRM, the Mosley Signal Master S-402 will do the trick! This 100% rust-proof 2-element beauty constructed of rugged heavy-wall aluminum is designed and engineered to provide the performance you need for both DX hunting and relaxing in a QRM free rag-chewing session. Beam is fed through link coupling, resulting in an excellent match over the entire bandwidth. $267.50

6 METER BEAMS



3 - 5 - 6 - 10 ELEMENTS

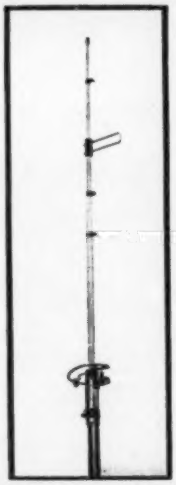
Proven performance from rugged, full size, 6 meter beams. Element spacings and lengths have been carefully engineered to give best pattern, high forward gain, good front to back ratio and broad frequency response.

Booms are .058 wall and elements are 3/4" - 5/8" .049 wall seamless chrome finish aluminum tubing. The 3 and 5 element beams have 1 3/8" - 1 1/4" booms. The 6 and 10 element beams have 1 5/8" - 1 1/2" booms. All brackets are heavy gauge formed aluminum. Bright finish cad plated ubolts are adjustable for up to 1 5/8" mast on 3 and 5 element and 2" on 6 and 10 element beams. All models may be mounted for horizontal or vertical polarization.

New features include adjustable length elements, kilowatt Reddi Match and built-in coax fitting for direct 52 ohm feed. These beams are factory marked and supplied with instructions for quick assembly.

Description	3 element	5 element	6 element	10 element
Model No.	A50-3	A50-5	A50-6	A50-10
Boom Lngth	6'	12'	20'	24'
Longest El.	117"	117"	117"	117"
Turn Radius	6'	7' 6"	11'	13'
Fwd. Gain	7.5 dB	9.5 dB	11.5 dB	13 dB
F/B Ratio	20 dB	24 dB	26 dB	28 dB
Weight	7 lbs.	11 lbs.	18 lbs.	25 lbs.

new
RINGO RANGER for FM



4.5 dB* – 6 dB**

Omnidirectional

GAIN

BASE STATION

ANTENNAS

FOR MAXIMUM PERFORMANCE AND VALUE

Cush Craft has created another first by making the world's most popular 2 meter antenna twice as good. The new Ringo Ranger is developed from the basic AR-2 with three half waves in phase and a one eighth wave matching stub. Ringo Ranger gives an extremely low angle of radiation for better signal coverage. It is tunable over a broad frequency range and perfectly matched to 52 ohm coax.

ARX-2, 137-160 MHz, 4 lbs., 112"
ARX-220, 220-225 MHz, 3 lbs., 75"
ARX-450, 435-450 MHz, 3 lbs., 39"

* Reference ½ wave dipole.
** Reference ¼ wave whip used as gain standard by many manufacturers.

Work full quieting into more repeaters and extend the radius of your direct contacts with the new Ringo Ranger.

You can up date your present AR-2 Ringo with the simple addition of this extende. kit. The kit includes the phasing network and necessary element extensions. The only modifications required are easy to make saw slits in the top section of your antenna.

ARX-2K CONVERSION KIT

2 METER ANTENNAS FM

A-FM RINGO 3.75 dB Gain (reference ¼ wave whip). Half wave length antennas with direct dc ground, 52 ohm feed takes PL-259, low angle of radiation with 1-1 SWR. Factory preassembled and ready to install. 6 meter partly preassembled, all but 450 MHz take 1¼" mast. There are more Ringos in use than all other FM antennas combined.

Model Number	AR-2	AR-25	AR-6	AR-220	AR-450
Frequency MHz	135-175	135-175	50-54	220-225	440-450
Power—Hdlg. Watts	100	500	100	100	250
Wind area sq. ft.	.21'	.21'	.37'	.20'	.10'

B-4 POLE Up to 9 dB Gain over a ½ wave dipole. Overall antenna length 147 MHz — 23' 220 MHz — 15', 435 MHz — 8', pattern 360° – 6 dB gain, 180° – 9 dB gain, 52 ohm feed takes PL 259 connector. Package includes 4 complete dipole assemblies on mounting booms, harness and all hardware. Vertical support mast not supplied.

AFM-4D 144 - 150 MHz, 1000 watts, wind area 2.58 sq. ft.
AFM-24D 220 - 225 MHz, 1000 watts, wind area 1.85 sq. ft.
AFM-44D 435 - 450 MHz, 1000 watts, wind area 1.13 sq. ft.

D-POWER PACK The big signal (22 element array) for 2 meter FM, uses two A147-11 yagis with a horizontal mounting boom, coaxial harness and all hardware. Forward gain 16 dB, F/B ratio 24 dB, ½ power beamwidth 42°, dimensions 144" x 80" x 40", turn radius 80", weight 15 lbs., 52 ohm feed takes PL-259 fitting.

A147-22 146 - 148 MHz, 1000 Watts, wind area 2.42 sq. ft.

D-YAGI STACKING KITS VPK includes horizontal mounting boom, harness, hardware and instructions for two vertically polarized yagis gives 3 dB gain over the single antenna.

A14-VPK,	complete 4 element stacking kit
A14-SK,	4 element coax harness only
A147-VPK,	complete 11 element stacking kit
A147-SK,	11 element coax harness only
A449-SK,	6 + 11 element coax harness only

E-4-6-11 ELEMENT YAGIS The standard of comparison in VHF-UHF communications, now cut for FM and vertical polarization. The four and six element models can be tower side mounted. All are rated at 1000 watts with direct 52 ohm feed and PL-259 connectors.

Model Number	A147-11	A-147-4	A449-11	A449-6	A220-11
Boom/Longest ele.	144"/40"	44"/40"	60"/13"	35"/26"	102"/26"
Wght./Turn radius	6 lbs., 72"	3 lbs., 44"	4 lbs., 60"	3 lbs., 18"	5 lbs., 51"
Gain/F/B ratio dB	13.2/28	9/20	13.2/28	11/25	13.2/28
½ Power beam	48°	66°	48°	60°	48°
Wind area sq. ft.	1.21	.43	.20	.20	.50
Frequency MHz	146-148	146-148	440-450	440-450	220-225

F-FM TWIST 12.4 dB Gain: Ten elements horizontal polarization for low end coverage and ten elements vertical polarization for FM coverage. Forward gain 12.4 dB, F/B ratio 22 dB, boom length 130", weight 10 lbs., longest element 40", 52 ohm Reddi Match driven elements take PL-259 connectors, uses two separate Feed lines.

A147-20T 145 - 147 MHz, 1000 watts, wind area 1.42 sq. ft.

HIGH PERFORMANCE VHF YAGIS

3/4 , 1-1/4, 2 METER BEAMS

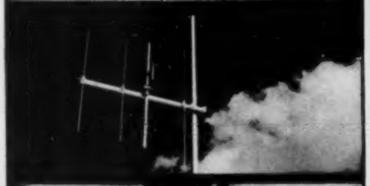
The standard of comparison in amateur VHF/UHF communications Cush Craft yagis combine all out performance and reliability with optimum size for ease of assembly and mounting at your site.

Lightweight yet rugged, the antennas have 3/16" O.D. solid aluminum elements with 5/16" center sections mounted on heavy duty formed brackets. Booms are 1" and 7/8" O.D. aluminum tubing. Mast mounts of 1/8" formed aluminum have adjustable u-bolts for up to 1-1/2" O.D. masts. They can be mounted for horizontal or vertical polarization. Complete instructions include data on 2 meter FM repeater operation.

New features include a kilowatt Reddi Match for direct 52 ohm coaxial feed with a standard PL-259 fitting. All elements are spaced at .2 wavelength and tapered for improved bandwidth.

Model No.	A144 7	A144 11	A220 11	A430 11
Description	2m	2m	1¼m	¾m
Elements	7	11	11	11
Boom Lngth.	98"	144"	102"	57"
Weight	4	6	4	3
Fwd. Gain	11 dB	13 dB	13 dB	13 dB
F/B Ratio	26 dB	28 dB	28 dB	28 dB
Fwd. Lobe @ ½ pwr. pt.	48	42	42	42
SWR @ Freq.	1 to 1	1 to 1	1 to 1	1 to 1

cushcraft CORPORATION



VHF/UHF BEAMS

A50-3	$ 32.95	A144-7	21.95
A50-5	49.95	A144-11	32.95
A50-6	69.95	A430-11	24.95
A50-10	99.95		

AMATEUR FM ANTENNAS

A147-4	$ 19.95	AFM-44D	54.95
A147-11	29.95	AR-2	21.95
A147-20T	54.95	AR-6	32.95
A147-22	84.95	AR-25	29.95
A220-7	21.95	AR-220	21.95
A220-11	27.95	AR-450	21.95
A449-6	21.95	ARX-2	32.95
A449-11	27.95	ARX-2K	13.95
AFM-4D	59.95	ARX-220	32.95
AFM-24D	57.95	ARX-450	32.95

	144 MHz.		220 MHz.		432 MHz.	
Description:	Model:	Price:	Model:	Price:	Model:	Price:
20 Element DX-Array	DX-120	42.95	DX-220	37.95	DX-420	32.95
Frame & Harness (40 E.)	DXK-140	59.95	DXK-240	54.95	DXK-440	39.95
Frame & Harness (80 El.)	DXK-180	109.95	DXK-280	89.95	DXK-480	79.95
1-1 52-ohm balun	DX-1BN	12.95	DX-2BN	12.95	DX-4BN	12.95
Vert. Pol. Bracket (20 El.)	DX-VPB	9.95	DX-VPB	9.95	DX-VPB	9.95

Tufts Radio Electronics • 209 Mystic Avenue • Medford MA 02155 • (617) 395-8280

For all you hams with little cars ...

We've got the perfect mobile rig for you.

Atlas-210
A.F. GAIN
R.F. GAIN

The Atlas 210x or 215x measures only 9½" wide x 9½" deep x only 3½" high, yet the above photograph shows how easily the Atlas transceiver fits into a compact car. And there's plenty of room to spare for VHF gear and other accessory equipment. With the exclusive Atlas plug-in design, you can slip your Atlas in and out of your car in a matter of seconds. All connections are made automatically.

BUT DON'T LET THE SMALL SIZE FOOL YOU!
Even though the Atlas 210x and 215x transceivers are less than half the size and weight of other HF transceivers, The Atlas is truly a giant in performance.

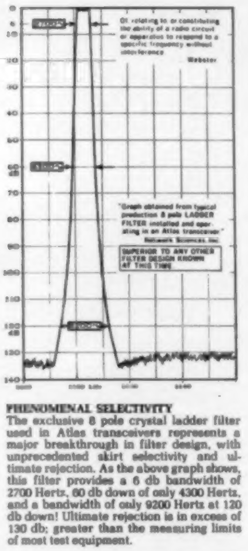
200 WATTS POWER RATING!
This power level in a seven pound transceiver is incredible but true. Atlas transceivers give you all the talk power you need to work the world barefoot. Signal reports constantly reflect great surprise at the signal strength in relation to the power rating.

FULL 5 BAND COVERAGE
The 210x covers 10-80 meters, while the 215x covers 15-160 meters. Adding the Atlas Model 10x Crystal Oscillator provides greatly increased frequency coverage for MARS and network operation.

NO TRANSMITTER TUNING OR LOADING CONTROLS
with Atlas' total broadbanding. With your Atlas you get instant QSY and band change.

MOST ADVANCED STATE OF THE ART SOLID STATE DESIGN
not only accounts for its light weight, but assures you years of top performance and trouble free operating pleasure.

PLUG-IN CIRCUIT BOARDS
and modular design provides for ease of servicing.



PHENOMENAL SELECTIVITY
The exclusive 8 pole crystal ladder filter used in Atlas transceivers represents a major breakthrough in filter design, with unprecedented skirt selectivity and ultimate rejection. As the above graph shows, this filter provides a 6 db bandwidth of 2700 Hertz, 60 db down of only 4300 Hertz, and a bandwidth of only 9200 Hertz at 120 db down! Ultimate rejection is in excess of 130 db; greater than the measuring limits of most test equipment.

EXCEPTIONAL IMMUNITY TO STRONG SIGNAL OVERLOAD AND CROSS MODULATION. The exclusive front end design in the receiver allows you to operate closer in frequency to strong neighboring signals than you have ever experienced before. If you have not yet operated an Atlas transceiver in a crowded band and compared it with any other receiver or transceiver, you have a real thrill coming.

A WORLD WIDE DEALER NETWORK TO SERVE YOU.
Whether you're driving a Honda in Kansas City or a Mercedes Benz in West Germany, there's an Atlas dealer near you.

Atlas 210x or 215x	$675.00
W/Noise Blanker	719.00
ACCESSORIES:	
AC Console 110/220 V	$147.00
Portable AC supply 110/220 V	100.00
Plug-in Mobile Kit	48.00
10x Osc. less crystals	59.00
Digital Dial DD-6B	229.00

For complete details see your Atlas dealer, or drop us a card and we'll mail you a brochure with dealer list.

ATLAS
RADIO INC.

mounts - leads - accessories

STANDARD GAIN MOBILES

Two Meters

- 5/8 wavelength — 3.4 db gain over 1/4 wave mobile
- Frequency coverage—143 to 149 MHz
- Power rating—200 watts FM

BBLT-144

MODEL BBLT-144
47" antenna complete with easy to install, no holes to drill, trunk lip mount, impact spring and 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount.
Price: $33.75

BBL-144

MODEL BBL-144
47" antenna mounts on any flat surface, roof, deck or fender in ⅜" hole. Includes impact spring, 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount.
Price: $31.65

HUSTLER "BUCK-BUSTER"

SF-2

MODEL SF-2
51" two meter, 5/8 wavelength, 3.4 db gain over 1/4 wave mobile. Designed with ⅜"-24 base to fit your mount or a wide selection of Hustler mobile mounts. (Mount or cable not included)
Price: $9.90

SUPER GAIN MOBILES

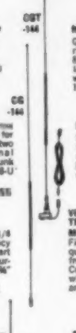
Two Meters

- 5.2 db gain over 1/4 wave mobile antenna
- Frequency coverage—143-149 MHz
- SWR at resonance—1.1:1 typical
- Power rating—200 watts FM

TWO AND SIX METERS— TRUNK LIP MOUNT
MODEL HFT
Four section telescopic antenna permits seperate adjustment for simultaneous resonance on two and six meters. Operational height: 40". Complete with trunk lip mount, 17' MIL SPEC RG-58-U and factory attached PL-259.
Price: $22.55

HFT

VHF/UHF ANTENNA— ROOF MOUNT
MODEL UNT-1
Field trimmable radiator for 1/4 wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Mounts on any flat surface, roof, deck, fender in ⅜" hole. Includes 15' RG-58-U.
Price: $9.95



CGT -144
CG -144

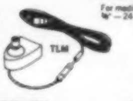
MODEL CGT-144
Get big signal performance, superior receiving capability with this 85" colinear antenna. Easy installation on side or edge of trunk lip without drilling — complete with 17' MIL SPEC RG-58-U and PL-259.
Price: $41.30

MODEL CG-144
Same characteristics as CGT-144 supplied with ⅜"-24 base to fit all mobile ball mounts — Length is 85". Mount and cable not included. Price: $25.50

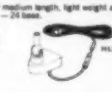
VHF/UHF ANTENNA— TRUNK LIP MOUNT
MODEL THF
Field trimmable radiator permits quarter wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Complete with trunk lip mount, 17' RG-58-U and PL-259. Price: $16.85

DELUXE MOBILE MOUNTS

For medium length, light weight antennas with ⅜" — 24 base.



TLM



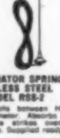
HLM

GCM-1

MODEL TLM
Trunk lip mount for no holes installation on side or edge of trunk lid. Includes 17' RG-58-U connectors attached.
Price: $14.85

MODEL HLM
Deluxe trunk lip mount with 180 degree swivel ball for positioning antenna to vertical. Easy — no holes — installation. Includes 17' RG-58-U cable and connectors attached. Price: $17.20

MODEL GCM-1
Rain gutter mount fits all shapes, angles even latest trim line gutters. Includes 180° swivel ball. Price: $9.80



UNT-1

THF

RESONATOR SPRING— STAINLESS STEEL
MODEL RSS-2
Installs between Hustler mast and resonator. Absorbs shock when antenna strikes overhanging obstructions. Supplied ready for easy installation. .... [illegible]

SSM-2

QD-1

STAINLESS STEEL BALL MOUNT FOR DECK, FENDER OR ANY FLAT SURFACE
MODEL SSM-2
Heavy 2" reinforced stainless steel 180° adjustable ball mount easily supports any amateur mobile antenna. Includes cycolac base, steel back-up plate and mounting hardware.
Price: $19.20

MM-1

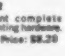
MODEL MM-1
Cowl mount installs in 1" hole. Includes 180° swivel ball and SO-239 connectors.
Price: $7.50

TGM-1

MODEL TGM-1
Trunk groove mount installs in hidden area of groove under trunk lid. Mounting hardware included. Price: $9.00

RSS-2

L-14-240



C-32

MODEL C-32
Ball mount complete with mounting hardware.
Price: $8.20

GS-144A

QUICK DISCONNECT— 100% STAINLESS STEEL
MODEL QD-1
Remove antenna from mount with easy press and twist release. Compression spring and all parts 100% stainless steel. ⅜"-24 threads—female one end, male the other.
Price: $16.95

FEED LINE **MODEL L-14-240**
Get known performance, maximum shielding for minimum noise pick-up in this MIL SPEC 20' length of RG-58-U cable. Supplied with connectors attached for use with ball or bumper mount and transceiver.
Price: $6.55

MODEL GS-144A — Deluxe, Two-Meter Colinear for Repeater or any fixed station operation. 6 db. gain over a ½ wave dipole. Maximum radiation at the horizon! Shunt fed with D.C. grounding. Radiator: ⅝ wave lower section, ¼ wave phasing, ⅝ wave upper section. Height: 117". SWR at resonance: 1.2:1 or better. Power rating: 1,000 Watts FM. Wind survival: 100 MPH. Installs on vertical pipe up to 1½" O.D. SO-239 coax connector Price: $67.95

RM

RMS

All resonators are precision wound with optimized design for each band. Assembly includes 17-7 PH stainless steel adjustable tip rod for lowest SWR and band edge marker. Choose for medium or high power operation.

STANDARD HUSTLER RESONATORS

Power Rating: 400 Watts SSB

Model	Band	Price
RM-10	10 meters	$ 6.50
RM-15	15 meters	6.95
RM-20	20 meters	7.30
RM-40	40 meters	13.20
RM-75	75 meters	15.50
RM-80	80 meters	15.95

SUPER HUSTLER RESONATORS

Power Rating: Legal Limit SSB

Supers have widest bandwidth

Model	Band	Price
RM-10S	10 meters	$11.30
RM-15S	15 meters	12.65
RM-20S	20 meters	13.00
RM-40S	40 meters	15.50
RM-75S	75 meters	30.00
RM-80S	80 meters	30.40

4-BTV

For 6-10-15-20-40-75-80 Meters

Fold over mast for quick and easy interchange of resonators or entering a garage. When operating, mast is held vertical with shakeproof sleeve clutch. 54" mast also serves as 1/4 wavelength 6 meter antenna. Stainless steel base has ⅜"-24 threads to fit mobile ball mount or bumper mount.

HUSTLER MASTS

The Majority Choice of Amateurs Throughout the World!

MODEL MO-2
For bumper mounting—Fold is at roof line 27" above base. Price: $22.00

MODEL MO-1
For deck or fender mounting—Fold is at roof line 15" above base. Price: $22.00

MO-1
MO-2

Covers 10 - 15 - 20 - 40 Meters

Only Hustler Gives One Setting for Whole Band Coverage

MODEL 4-BTV

- Lowest SWR—PLUS.
- Bandwidth at its broadest! SWR 1.6 to 1 or better at band edges.
- Hustler exclusive trap covers "Spritz" extruded to otherwise unattainable close tolerances assuring accurate and permanent trap resonance.
- Solid one inch fiberglass trap forms for optimum electrical and mechanical stability.
- Extra heavy duty aluminum mounting bracket with low loss—high strength insulators. Mounting hardware included.
- All sections 1¼" heavy wall, high strength aluminum.
- Stainless steel clamps permitting adjustment without damage to the aluminum tubing.
- Guaranteed to be easiest assembly of any multi-band vertical.
- Antenna has ⅜"-24 stud at top to accept RM-75 or RM-75-S Hustler resonator for 75 meter operation when desired.
- Top loading on 75 meters for broader bandwidth and higher radiation efficiency!
- Feed with any length 50 ohm coax.
- Power capability—full legal limit on SSB or CW.
- Mounting: Ground mount with or without radials, or roof mount with radials.

Length: 21' 5"
MODEL 4-BTV

Weight: 15 lbs.
Price: $99.95

HUSTLER

SUPER AMP from DenTron

LOADING
BAND
TUNING
TRANSMIT
DenTron
160-10 L Amplifier

If the amplifier you're thinking of buying doesn't deliver at least 1000 to 1200 watts output, to the antenna, you're buying the wrong amplifier.

Our New Super Amp is sweeping the country because hams have realized that the DenTron Amplifier will deliver to the antenna, (output power), what other manufacturers rate as input power.

The Super Amp runs a full 2000 watts P.E.P. input on SSB, and 1000 watts DC on CW, RTTY or SSTV 160-10 meters, the maximum legal power.

The Super Amp is compact, low profile, has a solid one-piece cabinet assuring maximum TVI sheilding.

The heart of our amplifier, the power supply, is a continuous duty, self-contained supply built for contest performance.

We mounted the 4-572B's, industrial workhorse tubes, in a cooling chamber featuring the on-demand variable cooling system.

The hams at DenTron pride themselves on quality work, and we fight to keep prices down. That's why the dynamic DenTron Linear Amplifier beats them all

$574.50

The 80-10 Skymatcher

Here's an antenna tuner for 80 through 10 meters, handles 500 w P.E.P. and matches your 52 ohm transceiver to a random wire antenna.

ANTENNA MATCHING
INDUCTANCE
DenTron RADIO
80-10 AT

- Continuous tuning 3.2 - 30 mc
- "L" network
- Ceramic 12 position rotary switch
- SO–239 receptional to transmitter
- Random wire tuner
- 3000 volt capacitor spacing
- Tapped inductor
- Ceramic antenna feed thru
- 7" W. 5" H. 8" D., Weight: 5 lbs.

$59.50

Read forward and reflected watts at the same time

Tired of constant switching and guesswork?

Every serious ham knows he must read both forward and reverse wattage simultaneously for that perfect match. So upgrade with the DenTron W-2 Dual in line Wattmeter.

$99.50

Match everything from 160 to 10 with the new 160-10 MAT

NEW: The Monitor Tuner was designed because of overwhelming demand. Hams told us they wanted a 3 kilowatt tuner with a built-in wattmeter, a front panel antenna selector for coax, balanced line and random wire. So we engineered the 160-10m Monitor Tuner. It's a lifetime investment at $299.50.

$299.50

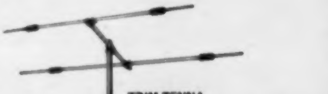
DenTron
Monitor Tuner

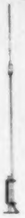
Meet the SuperTuner

The DenTron Super Tuner tunes everything from 160-10 meters. Whether you have balanced line, coax cable, random or long wire, the Super Tuner will match the antenna impedance to your transmitter. All DenTron tuners give you maximum power transfer from your transmitter to your antenna, and isn't that where it really counts?

1 KW MODEL **$129.50** 3 KW MODEL **$229.50**

The Sky Openers





SKYMASTER

A fully developed and tested 27 foot vertical antenna covers entire 10, 15, 20, and 40 meter bands using only one cleverly applied wave trap. A full 1/4 wave antenna on 20 meters. Constructed of heavy seamless aluminum with a factory tuned and sealed HQ Trap, SKYMASTER is weatherproof and withstands winds up to 80 mph. Handles 2 KW power level and is for ground, roof or tower mounting. Radials included in our low price of

$84.50

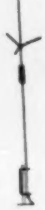
Also 80 m resonator for top mounting on SKYMASTER.

$29.50

TRIM-TENNA

The antenna your neighbors will love. The new DenTron Trim-Tenna with 20 meter beam is designed for the discriminating amateur who wants fantastic performance in an environmentally appealing beam. It's really loaded! Up front there's a 13 foot 8 inch director with precision Hy-Q coils. And, 7 feet behind is a 16 foot driven element fed directly with 52 ohm coax. The Trim-Tenna mounts easily and what a difference in on-the-air performance between the Trim-Tenna and that dipole, long wire or inverted Vee you've been using. 4 & 6 Forward Gain Over Dipole.

$129.50



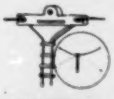
SKYCLAW

A tunable monoband high performance vertical antenna, designed for 40, 80, 160 meter operation. SKYCLAW gives you the following spectrum coverage:

BAND (Meters)	BANDWIDTH (kHz)
160	50
80	200
40	entire band

Tuning is easy and reliable. Rugged construction assures that this self-supporting unit is weatherproof and survives nicely in 100 mph winds.. Handles full legal power limit.

$79.50



ALL BAND DOUBLET

This All Band Doublet or Inverted Type Antenna covers 160 thru 10 meters. Has total length of 130 feet (14 ga. stranded copper) although it may be made shorter if necessary. This tuned Doublet is center fed through 100 feet of 450 ohm PVC covered balanced transmission line. The assembly is complete. Add rope to the ends and pull up into position. Tune with the DenTron Super Tuner and you're on 10 through 160 meters with one antenna! Now just for the DenTron All Band Doublet.

$24.50

EX-1

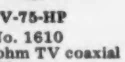
The DenTron EX-1 Vertical Antenna is designed for the performance minded antenna experimenter. The EX-1 is a full 40 meter, ¼ wave, 33', self-supporting vertical. The EX-1 is the ideal vertical for phasing.

$59.50

DenTron

DRAKE TVI FILTERS **High Pass Filters for TV Sets**

provide more than 40 dB attenuation at 52 MHz and lower. Protect the TV set from amateur transmitters 6-160 meters.



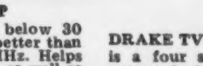
Drake TV-300-HP
Model No. 1603
For 300 ohm twin lead
Price: $10.60

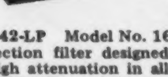
Drake TV-75-HP
Model No. 1610
For 75 ohm TV coaxial cable; TV type connectors installed
Price: $13.25

DRAKE TV-3300-LP
1000 watts max. below 30 MHz. Attenuation better than 80 dB above 41 MHz. Helps TV i-f interference, as well as TV front-end problems. Price: $26.60 Model No. 1608

LOW PASS FILTERS FOR TRANSMITTERS

have four pi sections for sharp cut off below channel 2, and to attenuate transmitter harmonics falling in any TV channel and fm band. 52 ohm. SO-239 connectors built in.





DRAKE TV-5200-LP
200 watts to 52 MHz. Ideal for six meters. For operation below six meters, use TV-3300-LP or TV-42-LP. Model No. 1609 Price: $26.60

DRAKE TV-42-LP Model No. 1605
is a four section filter designed with 43.2 MHz cut-off and extremely high attenuation in all TV channels for transmitters operating at 30 MHz and lower. Rated 100 watts input. Price: $14.60

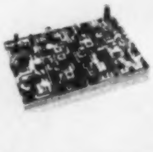
WORK ALL REPEATERS WITH OUR NEW SYNTHESIZER II

vhf engineering
synthesizer II

The Synthesizer II is a two meter frequency synthesizer. Frequency is adjustable in 5 kHz steps from 140.00 MHz to 149.995 MHz with its digital readout thumb wheel switching. Transmit offsets are digitally programmed on a diode matrix, and can range from 10 kHz to 10 MHz. No additional components are necessary!

Kit . . . . $169.95 Wired and tested$239.95

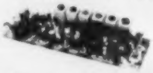
RECEIVERS



RX28C	28-35 MHz FM receiver with 2 pole 10.7 MHz crystal filter	$ 59.95
RX28C W/T . .	same as above–wired & tested . .	104.95
RX50C Kit . .	30-60 MHz rcvr w/2 pole 10.7 MHz crystal filter	59.95
RX50C W/T .	same as above–wired & tested . .	104.95
RX144C Kit .	140-170 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX144C W/T .	same as above–wired & tested . .	114.95
RX220C Kit . .	210-240 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX220C W/T .	same as above–wired & tested . .	114.95
RX432C Kit . .	432 MHz rcvr w/2 pole 10.7 MHz crystal filter	79.95
RX432C W/T .	same as above–wired & tested . .	124.95

RXCF	accessory filter for above receiver kits gives 70 dB adjacent channel rejection	8.50
RF28 Kit . . .	10 mtr RF front end 10.7 MHz out	12.50
RF50 Kit . . .	6 mtr RF front end 10.7 MHz out	12.50
RF144D Kit . .	2 mtr RF front end 10.7 MHz out	17.50
RF220D Kit . .	220 MHz RF front end 10.7 MHz out	17.50
RF432 Kit . . .	432 MHz RF front end 10.7 MHz out	27.50
IF 10.7F Kit .	10.7 MHz IF module includes 2 pole crystal filter	27.50
FM455 Kit . . .	455 KHz IF stage plus FM detector	17.50
AS2 Kit	audio and squelch board	15.00

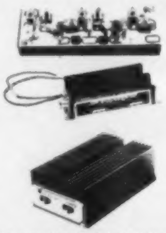
TRANSMITTERS



TX50	transmitter exciter, 1 watt, 6 mtr .	39.95
TX50 W/T . . .	same as above–wired & tested . .	59.95
TX144B Kit . .	transmitter exciter–1 watt–2 mtrs	29.95
TX144B W/T .	same as above–wired & tested. . .	49.95
TX220B Kit . .	transmitter exciter–1watt–220 MHz	29.95

TX220B W/T .	same as above–wired & tested . .	49.95
TX432B Kit . .	transmitter exciter 432 MHz . . .	39.95
TX432B W/T .	same as above–wired & tested . .	59.95
TX150 Kit . . .	300 milliwatt, 2 mtr transmitter .	19.95
TX150 W/T . .	same as above–wired & tested . .	29.95

POWER AMPLIFIERS

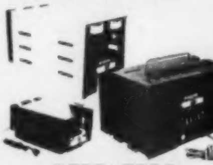


PA2501H Kit .	2 mtr power amp–kit 1w in–25w out with solid state switching, case, connectors	59.95
PA2501H W/T.	same as above–wired & tested . .	74.95
PA4010H Kit .	2 mtr power amp–10w in–40w out–relay switching	59.95
PA4010H W/T.	same as above–wired & tested . .	74.95
PA50/25 Kit .	6 mtr power amp, 1w in, 25w out, less case, connectors & switching .	49.95
PA50/25 W/T .	same as above, wired & tested. . .	69.95
PA144/15 Kit .	2 mtr power amp–1w in–15w out–less case, connectors and switching	39.95
PA144/25 Kit .	same as PA144/15 kit but 25w . .	49.95
PA220/15 Kit .	similar to PA144/15 for 220 MHz	39.95
PA432/10 Kit .	power amp–similar to PA144/15 except 10w and 432 MHz	49.95
PA140/10 W/T	10w in–140w out–2 mtr amp . .	179.95
PA140/30 W/T	30w in–140w out–2 mtr amp . .	159.95

Blue Line . . . RF power amp, wired & tested, emission–CW-FM-SSB/AM

Model	Frequency	Power Input	Power Output	
BLB 3/150	45- 55MHz	3W	150W	TBA
BLC 10/70	140-160MHz	10W	70W	139.95
BLC 2/70	140-160MHz	2W	70W	159.95
BLC 10/150	140-160MHz	10W	150W	259.95
BLC 30/150	140-160MHz	30W	150W	239.95
BLD 2/60	220-230MHz	2W	60W	159.95
BLD 10/60	220-230MHz	10W	60W	139.95
BLD 10/120	220-230MHz	10W	120W	259.95
BLE 10/40	420-470MHz	10W	40W	139.95
BLE 2/40	420-470MHz	2W	40W	159.95
BLE 30/80	420-470MHz	30W	80W	259.95
BLE 10/80	420-470MHz	10W	80W	289.95

POWER SUPPLIES



PS15C Kit . . .	15 amp–12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection . .	79.95
PS15C W/T . .	same as above–wired & tested . .	94.95
PS25C Kit . . .	25 amp–12 volt regulated power supply w/case, w/fold-back current limiting and ovp	129.95
PS25C W/T . .	same as above–wired & tested . .	149.95
PS25M Kit. . .	same as PS25C with meters	149.95
PS25M W/T . .	same as above–wired & tested . .	169.95

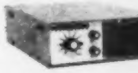
O.V.P.	adds over voltage protection to your power supplies, 15 VDC max. . .	9.95
PS3A Kit . . .	12 volt–power supply regulator card with fold-back current limiting . .	8.95
PS3012 W/T .	new commercial duty 30 amp 12 VDC regulated power supply w/case, w/fold-back current limiting and overvoltage protection	239.95

REPEATERS

RPT50 Kit . . .	repeater–6 meter	465.95
RPT50	repeater–6 meter, wired & tested	695.95
RPT144 Kit . .	repeater–2 mtr–15w–complete (less crystals)	465.95
RPT220 Kit . .	repeater–220 MHz–15w–complete (less crystals)	465.95
RPT432 Kit . .	repeater–10 watt–432 MHz (less crystals)	515.95
RPT144 W/T .	repeater–15 watt–2 mtr	695.95
RPT220 W/T .	repeater–15 watt–220 MHz. . . .	695.95
RPT432 W/T .	repeater–10 watt–432 MHz. . . .	749.95
DPLA50	6 mtr close spaced duplexer	575.00

DPLA144 . . .	2 mtr. 600 KHz spaced duplexer, wired and tuned to frequency . . .	379.95
DPLA220 . . .	220 MHz duplexer, wired and tuned to frequency	379.95
DPLA432 . . .	rack mount duplexer	319.95
DSC-U	double shielded duplexer cables with PL259 connectors (pr.) . . .	25.00
DSC-N	same as above with type N connectors (pr.)	25.00

TRANSCEIVERS



TRX50 Kit . .	Complete 6 mtr FM transceiver kit, 20w out, 10 channel scan with case (less mike and crystals).	249.95
TRX144 Kit .	same as above, but 2 mtr & 15w out	219.95
TRX220 Kit .	same as above except for 220 MHz	219.95
TRX432 Kit .	same as above except 10 watt and 432MHz	254.95
TRC-1	transceiver case only	19.95
TRC-2	transceiver case and accessories . .	39.95

SYNTHESIZERS

SYN II Kit. . .	2 mtr synthesizer, transmitt offsets programmable from 100 KHz–10 MHz, (Mars offsets with optional adapters)	169.95
SYN II W/T . .	same as above–wired & tested . .	239.95
MO-1 Kit. . . .	Mars/cap offset optional	2.50
TO-1 Kit	18 MHz optional tripler	2.50

WALKIE-TALKIES

HT 144B Kit .	2 mtr, 2w, 4 channel, hand held receiver with crystals for 146.52 simplex .	129.95
NICAD	battery pack, 12 VDC, ½ amp. . .	29.95
BC12	battery charger for above	5.95
Rubber Duck .	2 mtr, with male BNC connector .	8.95

OTHER PRODUCTS BY VHF ENGINEERING

CD1 Kit	10 channel receive xtal deck w/diode switching. . . . . $	6.95
CD2 Kit	10 channel xmit deck w/switch and trimmers	14.95
CD3 Kit	UHF version of CD1 deck, needed for 432 multi-channel operation.	12.95
COR2 Kit . . .	carrier operated relay.	19.95
SC3 Kit	10 channel auto-scan adapter for RX with priority	19.95
Crystals	we stock most repeater and simplex pairs from 146.0-147.0 (each). .	5.00
CWID Kit . . .	159 bit, field programmable, code identifier with built-in squelch tail and ID timers	39.95
CWID	wired and tested, not programmed	54.95
CWID	wired and tested, programmed .	59.95
MIC I	2,000 ohm dynamic mike with P.T.T. and coil cord	12.95
TS1 W/T	tone squelch decoder	59.95
TS1 W/T	installed in repeater, including interface accessories	89.95
TD3 Kit	2 tone decoder	29.95
TD3 W/T . . .	same as above–wired & tested .	39.95
HL144 W/T . .	4 pole helical resonator, wired & tested, swept tuned to 144 MHz ban . .	24.95
HL220 W/T . .	same as above tuned to 220 MHz ban	24.95
HL432 W/T . .	same as above tuned to 432 MHz ban	24.95

Vhf engineering

THE WORLD'S MOST COMPLETE LINE OF VHF-FM KITS AND EQUIPMENT

Tufts Radio Electronics ● 209 Mystic Avenue ● Medford MA 02155 ● (617) 395-8280

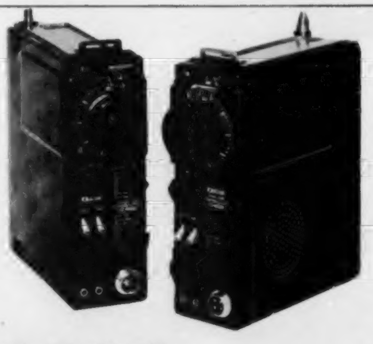
Now It's Crystal Clear

Yes, now ICOM helps you steer clear of all the hassles of channel crystals. The new **IC-22S** is the same surprising radio you've come to know and love as the **IC-22A**, except that it is totally crystal independent. **Zero crystals.** Solid state engineering enables you to program 23 channels of your choice without waiting. Now the ICOM performance you've demanded comes with the convenience you've wanted, with your new **IC-22S.**

Price: $299.00

IC-245 Transceiver
The VFO Revolution goes mobile with the unique, ICOM developed LSI synthesizer with 4 digit LED readout. The IC-245 offers the most for mobile on the market. The easy to use tuning knob moves accurately over 50 detent steps and assures excellent control as easily as steering the vehicle. With its optional adapter, the IC-245 puts you into all mode operation on 12V DC power with a compact dash-mounted transceiver. In FM, the synthesizer command frequency is displayed in 5 kHz steps from 146 to 148 MHz, and with the side band adapter the step rate drops to 100 Hz from 144 to 146 MHz. For maximum repeater flexibility, the transmit and receive frequencies are independently programmable on any separation. The IC-245 even comes equipped with a multiple pin Molex connector for remote control. The IC-245 is a product of the revolution in VFO design, from its new style front panel, to its excellent mechanical rigidity and Large Scale Integrated Circuitry. Your IC-245 will give you the most for mobile. $499.00

THE NEW ICOM 4 MEG, MULTI-MODE, 2 METER RADIO – IC 211
ICOM introduces the first of a great new wave of amateur radios, with new styling, new versatility, new integration of functions. You've never before laid eyes on a radio like the IC-211, but you'll recognize what you've got when you first turn the single-knob frequency control on this compact new model. The IC-211 is fully synthesized in 100 Hz or 5 kHz steps, with dual tracking, optically coupled VFOs displayed by seven-segment LED readouts, providing any split. The IC-211 rolls through 4 megahertz as easily as a breaker through the surf. With its unique ICOM developed LSI synthesizer, the IC-211 is now the best "do everything" radio for 2 meters, with FM, USB, LSB and CW operation. $749.00



Hold it!

Take hold of SSB with these two low cost twins. ICOM'S new portable **IC-202** and **IC-502** put it within your reach wherever you are. You can take it with you to the hill top, the highways, or the beach. Three portable watts PEP on two meters or six!

Hello, DX! The ICOM quality and excellent receiver characteristics of this pair make bulky converters and low band rigs unnecessary for getting started in SSB-VHF. You just add your linear amp, if you wish, connect to the antenna, and DX! With the **202** you may talk through OSCAR VI and VII! Even transceive with an "up" receiving converter! The **IC-502**, similarly, makes use of six meters in ways that you would have always liked but could never have before. In fact, there are so many things to try, it's like opening a new band.

Take hold of Single Side Band. Take hold of some excitement. Take two.

IC-202
2 Meter SSB • 3 Watts PEP • True IF Noise Blanker
Switched Dial Lights • Internal Batteries • 200KHz
VXO Tuning • 144.0, 144.2 + 2 More! • RIT!
Price: $259.00

IC-502
6 Meter SSB • 3 Watts PEP • True IF Noise Blanker
Switched Dial Lights • Internal Batteries • 800KHz
VFO • RIT!
Price: $249.00

Now ICOM Introduces 15 Channels of FM to Go!

The New IC-215: the FM Grabber

This is ICOM's first FM portable, and it puts good times on the go. Change vehicles, walk through the park, climb a hill, and ICOM quality FM communications go right along with you. Long lasting internal batteries make portable FM really portable, while accessible features make conversion to external power and antenna fast and easy.

Grab for flexibility with the new **IC-215** FM portable.

- Front mounted controls and top mounted antenna
- Narrow filter (15KHz — compatible spacing)
- 15 channels (12 on dial / 3 priority)
- Fully collapsible antenna
- Compatible mount feature for flexible antenna
- Dual power (3 watts high / 400 mw low, nominal)
- External power and antenna easily accessible
- Lighted dial and meter

Price: $229.00

Your new IC-215 comes supplied with: 5 popular channels; handheld mic, with protective case; shoulder strap; connectors for external power and speaker; 9 long-life C batteries.

ICOM

model 333 dummy load wattmeter

Favorite Lightweight Portable—250 WATT RATING—Air Cooled

Ideal field service unit for mobile 2-way radio—CB, marine, business band. Best for QRP amateur use, CB, with zero to 5 watts full scale low power range.

• specifications

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	250 watts intermittent
Wattmeter Ranges	0—5, 0—50, 0—125, 0—250
Connector	SO-239
Size	4" x 7" x 6"
Shipping Weight	2 lbs.
Price	$66.50

_model 374 dummy load wattmeter__

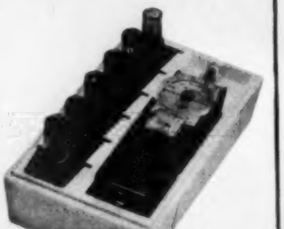
Top of the Line—1500 WATT RATING—Oil Cooled

Our highest power combination unit. Rated to 1500 watts input (intermittent). Meter ranges are individually calibrated for highest accuracy.

• specifications

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	1500 watts DC intermittent. Warning light* signals maximum heat limit.
Wattmeter Ranges	0—15, 0—50, 0—300, 0—1500
Input Connector	SO-239 (hermetically sealed)
Size	4-3/4" x 9" x 10-1/4"
Shipping Weight	12 lbs.
Price	$215.00

LITTLE DIPPER



model 331A

transistor dip meter_

Portable RF single generator, signal monitor, or absorption wavemeter. Lightweight (1 pound, 6 ounces with all coils), battery-powered unit is ideal for field use in testing transceivers, tuning antennas, etc. Can also be used to measure capacity, inductance, circuit Q, and other factors. Indispensable for experimenters, it is easily the most versatile instrument in the shop. Continuous coverage from 2 MHz to 230 MHz in seven ranges.

Unit consists of a transistorized RF dip oscillator and 100-microampere meter circuit. Meter circuit uses a single-transistor DC amplifier with a potentiometer in the emitter circuit to control meter sensitivity. A 3-position slide switch connects the meter circuit to the oscillator for dip measurements, to a diode for absorption wavemeter peak measurements, or provides audio modulation of the RF signal.

Frequency dial has a calibrated reference point for Q and bandwidth measurements. Each coil has its own frequency dial: there's no confusion with multiple markings or small, hard-to-read scales near the center of the dial.

• specifications

Frequency Coverage	2 MHz to 230 MHz in 7 overlapping ranges by plug-in coil assemblies: 2 MHz—4 MHz, 4 MHz—8 MHz, 8 MHz—16 MHz, 16 MHz—32 MHz, 32 MHz—64 MHz, 50 MHz—110 MHz, 110 MHz—230 MHz
Accuracy	±3%
Modulation	1000 Hz, 25% to 40%
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	7" x 2-1/4" x 2-1/2"
Shipping Weight	1 lb., 6 oz.
Price	$120.00

BARKER & WILLIAMSON, INC.

Economy High Power Load—1500 WATT RATING—Oil Cooled

model 384 dummy load

For high power when all you need is the load.

• specifications

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	1500 watts intermittent. Warning light* signals maximum heat limit.
Connector	SO-239 (hermetically sealed)
Size	4-3/4" x 9" x 10-1/2"
Shipping Weight	12 lbs.
Price	$94.50

High Power—1000 WATT RATING—Oil Cooled

model 334A dummy load wattmeter.

Our most popular combination unit. Handles full amateur power. Meter ranges individually calibrated. Can be panel mounted.

• specifications

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	1000 watts CW intermittent. Warning light* signals maximum heat limit.
Wattmeter Ranges	0—10, 0—100, 0—300, 0—1000
Input Connector	SO-239 (hermetically sealed)
Size	4-3/4" x 9" x 10-1/4"
Shipping Weight	12 lbs.
Price	$174.00

WIDE RANGE ATTENUATOR

Model 371-1

Protect your receiver or converter from overload, or provide step attenuation of low-level RF signals from signal generators, preamplifiers, or converters. Seven rocker switches provide attentuation from 1 dB to 61 dB in 1-dB steps. Switches are marked in dB, 1-2-3-5-10-20-20. Sum of actuated switches (IN position) gives attenuation. With all switches in OUT position, there is NO insertion loss. Attenuator installs in coaxial line using UHF connectors.

• specifications

Power Capacity	1/4 watt
VSWR	1.3:1 maximum, DC to 225 MHz
Impedance	50 ohms
Accuracy	1 dB/dB, DC to 60 MHZ 0.1 dB/dB ±0.5 dB, DC to 160 MHz 0.1 dB/dB ±1.0 dB, DC to 225 MHz
Size	8-1/2" x 2-1/2" x 2-1/4"
Shipping Weight	1-1/2 lbs.
Price	$48.50

-C – LINE AMATEUR EQUIPMENT **DRAKE** —COMMUNICATIONS RECEIVERS-

Drake R-4C

Solid State Linear permeability-tuned VFO with 1 kHz dial divisions. Gear driven dual circular dials. High mechanical, electrical and temperature stability.

Covers ham bands with crystals furnished. Covers all of 80, 40, 20 and 15 meters, and 28.5-29.0 MHz of 10 meters.

Covers 160 meters with accessory crystal. In addition to the ham bands, tunes any fifteen 500 kHz ranges between 1.5 and 30 MHz, 5.0 to 6.0 MHz not recommended. Can be used for MARS, WWV, CB, Marine and Shortwave broadcasts.

Superior selectivity: 2.4 kHz 8-pole filter provided in ssb positions. 8.0 kHz, 6 pole selectivity for a-m. Optional 8-pole filters of .25, .5, 1.5 and 6.0 kHz bandwidths available.

Tunable notch filter attenuates carriers within passband.

Smooth and precise passband tuning.

Transceive capability; may be used to transceive with the T-4X, T-4XB or T-4XC Transmitters. Illuminated dial shows which PTO is in use.

Usb, lsb, a-m and cw on all bands.

Agc with fast attack and two release times for ssb and a-m or fast release for break-in cw. Agc also may be switched off.

New high efficiency accessory noise blanker that operates in all modes.

Crystal lattice filter in first i-f prevents cross-modulation and desensitization due to strong adjacent channel signals.

Excellent overload and intermodulation characteristics.

25 kHz Calibrator permits working closer to band edges and segments.

Scratch resistant epoxy paint finish.

Price: $599.00

Drake T-4XC

Solid State Linear permeability-tuned VFO with 1 kHz dial divisions. Gear driven dual circular dials. High mechanical, electrical and temperature stability.

Covers ham bands with crystals furnished. Covers all of 80, 40, 20 and 15 meters, and 28.5-29.0 MHz of 10 meters.

Covers 160 meters with accessory crystal. Four 500 kHz ranges in addition to the ham bands plus one fixed-frequency range can be switch-selected from the front panel.

Two 8-pole crystal lattice filters for sideband selection.

Transceives with the R-4, R-4A, R-4B, R-4C and SPR-4 Receivers. Switch on the T-4XC selects frequency control by receiver or transmitter PTO or independently. Illuminated dial shows which PTO is in use.

Usb, lsb, a-m and cw on all bands.

Controlled-carrier modulation for a-m is compatible with ssb linear amplifiers.

Automatic transmit-receive switching. Separate VOX time-delay adjustments for phone and cw. VOX gain is independent of microphone gain.

Choice of VOX or PTT. VOX can be disabled by front panel switch.

Adjustable pi network output.

Transmitting agc prevents flat-topping.

Meter reads relative output or plate current with switch on load control.

Built-in cw sidetone.

Spotting function for easy zero-beating.

Easily adaptable to RTTY, either fsk or afsk.

Compact size; rugged construction. Scratch resistant epoxy paint finish.

Price: $599.00

Drake SPR-4 – $629.00

- **Programmable to meet specific requirements: SWL, Amateur, Laboratory, Broadcast, Marine Radio, etc.**
- **Direct frequency dialing: 150-500 kHz plus any 23 500 kHz ranges, 0.5 to 30 MHz**
- **FET circuitry, all solid state**
- **Linear dial, 1 kHz readout**
- **Band-widths for cw, ssb, a-m with built-in LC filter**
- **Crystals supplied for LW, seven SW, and bc bands**
- **Notch filter**
- **Built-in speaker**

Drake DSR-2 – $2950.00

- **Continuous Coverage 10 kHz to 30 MHz**
- **Digital Synthesizer Frequency Control**
- **Frequency Displayed to 100 Hz**
- **All Solid State**
- **A-m, Ssb, Cw, RTTY, lsb**
- **Series Balanced Gate Noise Blanker**
- **Front End Protection**
- **Optional Features Available on Special Order**

Power Supplies

Power Supplies for T-4, T-4X, T-4XB or T-4XC (The AC-4 can be housed in an MS-4 speaker cabinet).

Model No. 1501 Drake AC-4 $120.00
Model No. 1505 Drake DC-4 $135.00

Drake MS-4

Drake MS-4 Matching Speaker for use with R-4, R-4A, R-4B and R-4C Receivers. (Has space to house AC-3 and AC-4 Power Supplies) **Price: $24.95**

Accessories

DRAKE MICROPHONES

Wired for use with Drake transmitters and transceivers, for either push-to-talk or VOX. Type of operation is determined by the VOX control setting of the transmitter.

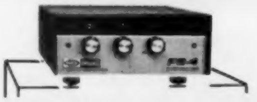
Desk Type Model No. 7075

• **Type:** Heavy Duty Ceramic Desk Top • **Cable:** Four Foot, 3-Conductor, One Shield • **Output Level:** Minus 54 dB (0 dB = 1 volt/microbar) • **Frequency Reponse:** 80-7000 Hz • **Switching:** Adapts to either push-to-talk or VOX. **Price: $39.00**

Hand-Held Type Model No. 7072

• **Type:** Ceramic, hand held • **Cable:** 11" Retracted, 5' extended, PVC 3 Cord, 1 shielded, Coil Cord • **Case:** Cycolac • **Finish:** Gray • **Output Level:** Minus 65 dB (0 dB = 1 volt/microbar) • **Frequency Response:** 300-3000 Hz • **Switching:** Adapts to either push-to-talk or VOX.

Price: $19.00

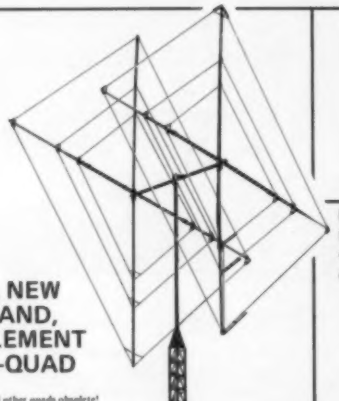


Drake FS-4
Digital Synthesizer – $250.00

The new solid state Drake FS-4 Synthesizer opens the door to a new world of continuous-tuning short wave! Combines synthesized general coverage flexibility with the selectivity, stability, frequency readout and reliability of the Drake R-4C or SPR-4 Receivers.

• Interfaces with all R-4 series receivers and T-4X series transmitters: (R-4, R-4A, R-4B, R-4C, SPR-4, T-4, T-4X, T-4XB and T-4XC), without modification. • MHz range is set on FS-4, with kHz readout taken from receiver dial. • Complete general coverage—no range crystals to buy. • T-4/T-4X series transmitters transceive on any FS-4 frequency, when used with R-4 series receivers. • Readout 1 kHz with Drake PTO.

Price: $250.00



ALL NEW 3–BAND, 2 ELEMENT HY–QUAD

- Makes all other quads obsolete!
- Complete – nothing else to buy
- High strength, low wind load

The Hy-Quad from Hy-Gain makes all other quads obsolete! Here's why:
First, it's the only quad that is complete. There is nothing more to shop for or buy.
Secondly, it is uniquely designed so that it overcomes all of the previously undesirable features inherent in quads.
The all aluminum structure stays up! The single feed line and diamond shape simplifies feed line routing.
Hy-Gain's all new Hy-Quad will outdo all other quads because it's engineered to do just that. The Hy-Quad is new, it's superior, it's complete. It's the first quad to have everything: spreaders are broken up at strategic electrical points with Cycoloc insulators / tri-band 2 element construction with individually resonated elements with no interaction / Hy-Quad requires only one feed line for all three bands / individually tuned gamma matches on each band with Hy-Gain exclusive vertex feed / full wave element loops require no tuning stubs, traps, loading coils or baluns / heavy duty mechanical construction of strong swaged aluminum tubing and die formed spreader-to-boom clamps / extra heavy duty universal boom-to-mast clamp that tilts and mounts on any mast 1¼" to 2½" in diameter / aluminum stranded wire. You can open and close the bands with this antenna. You'll experience the thrill of real DX.

Order No. 244 Price: $219.95

SPECIFICATIONS

Overall length of spreaders	29'5"	Forward gain	8.5 db
Turning radius	13'6"	Input impedance	52 ohms
Weight	42 lbs.	VSWR	1.2:1 or better at resonance on all bands
Boom diameter	2"		
Boom length	8'	Power	Maximum legal
Mast diameter	1¼" to 2½"		
Wind survival	100 mph	Front-to-back ratio	25-35 db depending upon electrical height
Surface area	6.4 sq. ft.		
Wind load at 100 mph	256.0 lbs.	Polarization	Horizontal

The Versatile Model 18V for 80 thru 10 Meters

The Model 18V is a low-cost, highly efficient vertical antenna that can be tuned to any band...80 thru 10 meters...by a simple adjustment of the feed point on the matching base inductor. Fed with 52 ohm coax, this 18 ft. radiator is amazingly efficient for DX or local contact. Constructed of heavy gauge aluminum tubing, theModel 18V may be installed on a short 1¾ inch mast driven into the ground. It is also adaptable to roof or tower mounting. Highly portable, the Model 18V can be quickly knocked down to an overall length of 5 ft. and easily re-assembled for field days and camping trips. Shpg. Wt., 5 lbs.
Order No. 193 Price: $33.00

WIDE BAND VERTICAL
for 80 - 10 Meters
Hy-Gain's 18 AVT/WB

Take the wide band, omni-directional performance of Hy-Gain's famous 14AVQ/WB, add 80 meter capability plus extra-heavy duty construction—and you have the unrivalled new 18AVT/WB. In other words, you have quite an antenna.

- Automatic switching, five band capability is accomplished through the use of three beefed-up Hy-Q traps (featuring large diameter coils that develop an exceptionally favorable L/C ratio).
- Top loading coil.
- Across-the-band performance with just one furnished setting for each band (10 through 40).
- True 1/4 wave resonance on all bands.
- SWR of 2:1 or less at band edges.
- Radiation pattern has an outstandingly low angle whether roof top or ground mounted.

CONSTRUCTION . . . of extra-heavy duty tapered swaged seamless aluminum tubing with full circumference, corrosion resistant compression clamps at slotted tubing joints . . . is so rugged and rigid that, although the antenna is 25' in height, it can be mounted without guy wires, using a 12" double grip mast bracket, with recessed coax connecter.

Order No. 386 Price: $97.00

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hy-gain

For 10, 15, and 20 Meters
New Hy-Gain Model 12 AVQ

Completely self-supporting, the Model 12AVQ features Hy-Q traps...12" double-grip mast bracket...taper swaged seamless aluminum construction with full circumference compression clamps at tubing joints. It delivers outstanding low angle radiation. SWR is 2:1 or less on all bands. Overall height is 13'6". Shipping weight 7.2 lbs. Price: $47.00

Order No. 384

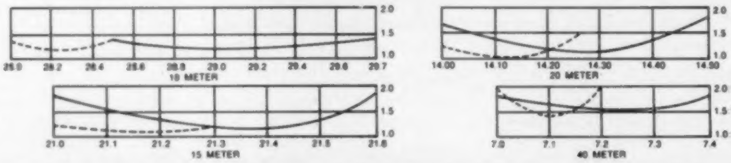
New, improved successor to the world's most popular vertical!
Hy-Gain Model 14 AVQ/WB for 40-10 Meters.

- **Wide band performance with one setting (optimum settings for top performance furnished)**
- **New Hy-Q Traps**
- **New 12" Double-Grip Mast Bracket**
- **Taper Swagged Seamless Aluminum Construction**

The Model 14AVQ/WB, new improved successor to the world famous Model 14AVQ, is a self-supporting, automatic band switching vertical that delivers omni-directional performance on 40 through 10 meters. Three separate Hy-Q traps featuring large diameter coils that develop an exceptionally favorable L/C ratio and a very high Q, provide peak performance by effectively isolating sections of the antenna so that a true 1/4 wave resonance exists on all bands. Outstandingly low angle radiation pattern makes DX and other long haul contacts easy. Superior mechanical features include solid aluminum housing for traps using air dielectric capacitor...heavy gauge taper swaged seamless aluminum radiator...full circumference compression clamps at tubing joints that are resistant to corrosion and wear...and a 12" double-grip mast bracket that insures maximum rigidity whether roof-top or ground mounted. The Model 14AVQ/WB also delivers excellent performance on 80 meters using Hy-Gain Model LC-80Q Loading Coil. Overall height is 18 feet. Shipping weight 9.2 lbs. Unsurpassed portability...outstanding for permanent installations. Price: $67.00

Order No. 385

TYPICAL 14AVQ/WB VSWR CURVES



ROOF MOUNTING KIT—Model 14RMQ provides rugged support for Model 14AVQ/WB.
Order No. 184 Price: $24.95

Hy-Gain REEL TAPE PORTABLE DIPOLE for 10 thru 80 Meters Model 18TD

The most portable high performance dipole ever...

The Model 18TD is unquestionably the most foolproof high performance portable doublet antenna system ever developed. It has proven invaluable in providing reliable communications in vital military and commercial-applications throughout the world. Two stainless steel tapes, calibrated in meters, extend from either side of the main housing up to a total distance of 132 feet for 3.5 mc operation. 25 ft. lengths of polypropylene rope attached to each tape permits installation to poles, trees, buildings...whatever is available for forming a doublet antenna system. Integrated in the high impact housing is a frequency to length conversion chart calibrated to meter measurements on the tapes...makes installation foolproof. Feeds with 52 ohm coax. Delivers outstanding performance as a portable or permanent installation. Measures 10x5½x2 inches retracted. Wt., 4.1 lbs.
Order No. 228 Price: $94.95

DenTron MLA-2500 $799.50

DenTron Radio has packed all the features a linear amplifier should have into their new MLA-2500. Any Ham who works it can tell you the MLA-2500 really was built to make amateur radio more fun.

- ALC circuit to prevent overloading
- 160 thru 10 meters
- 1000 watts DC input on CW, RTTY or SSTV Continuous Duty
- Variable forced air cooling system
- Self-contained continuous duty power supply
- Two EIMAC 8875 external anode ceramic/metal triodes operating in grounded grid
- Covers MARS frequencies without modifications
- 50 ohm input and output impedance
- Built-in RF wattmeter
- 117V or 234V AC 50-60 hz
- Third order distortion down at least 30 db
- Frequency range:
  1.8MHz (1.8-2.5) 3.5MHz (3.4-4.6)
  7MHz (6.0-9.0) 14MHz (11.0-16.0)
  21MHz (16.0-22.0) 28MHz (28.0-30.0)
- 40 watts drive for 1 KW DC input
- Rack mounting kit available (19" rack)
- Size: 5½" H x 14" W x 14" D Wt. 47 lbs.

Pipo Communications TROUBLE FREE TOUCH-TONE ENCODER

POSITIVE TOUCH (KEYS DEPRESS) ● MOBILE ● HANDHELD
DESK MOUNT ● NO POTTED PARTS (SERVICEABLE)
MIL. SPEC. COMPONENTS ● NO RFI ● SELF CONTAINED
XTAL CONTROLLED ● LEVEL ADJUSTABLE FROM FRONT
Pat. Pend.

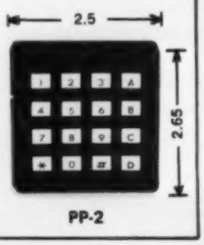
M series is for mounting to surfaces inaccessible from the rear, walls - mobiles - systems interface - panels - test equipment, etc.

K series is self contained with a relay inside the encoder. When Keys are pressed contact closer occurs with a 2 sec. delay, (adjustable). Contacts are rated at 110ma @ 28 Volts switched, 500ma carry. PP-2K contains delay exclusion for the forth column. However, by jumpering D-5, 4th column delay is restored.

Pipo Communications has developed a trouble free reliable instrument to be free of any defects for years. Unit is constructed with the best compunents available, without compromise in quality. Unit is operable from 4.5 - 60 Volts at temperatures from below 0 to + 140°F. Output level will drive any transmitter or system. Adjustable output level is controlled with an extremely stable multiturn trimpot, with access from the front of the encoder (not behind), saving time for level setting, which amounts to hours when involved with a system.

PP-1 [illegible] 12 Keys
PP-1m [illegible] [illegible]
PP-1K [illegible] Add $1.00
PP-2 [illegible] 16 Keys
PP-2m [illegible] [illegible]
PP-2K [illegible] Add $1.00
PP-1A [illegible] For Standard Comm. Hand Held

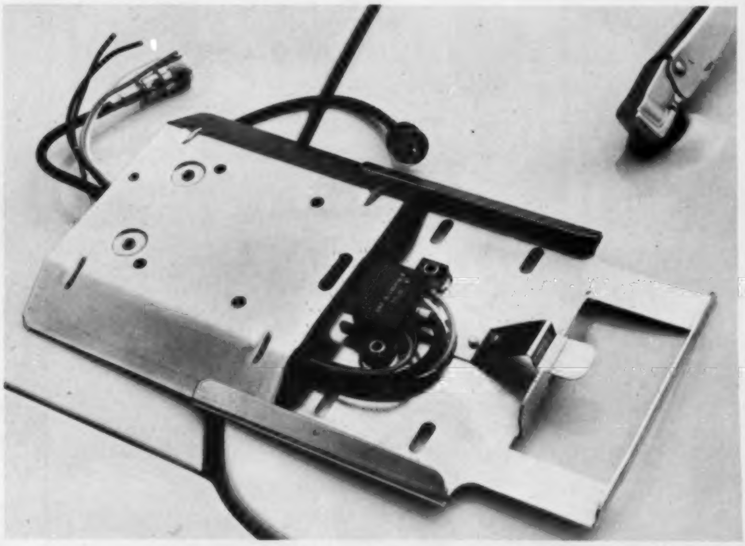
PP-1



PP-2

STOP
A
THIEF!

SAVE YOUR RADIO!



DESIGNED FOR COMMERCIAL USE UP TO 1000 MHZ.

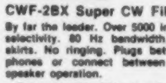
The **TUFTS SAVE-YOUR-RADIO** bracket can save you a bundle ... and a lot of hassle. Why worry about rig ripoff? The **TUFTS SYR** bracket mounts quickly and easily in your car and makes it possible to snap your rig out of its bracket when you park and put it out of sight.

The connector system has a special coaxial cable connector which will provide you with a lossless connection right up to 1000 MHz! No loss! In addition to the quick coax connector there are also four power and accessory connections which are made automatically when the rig is slid into its bracket ... just what you need for feeding power and loudspeaker connections to the set.

This is a rugged bracket and connector system ... it'll take a beating. There is a hole on each side of the 16 gauge steel plate for a padlock in case you want to leave the rig for short periods in its bracket. They'll have to rip out the dash to get it ... and it won't be the first time for that.

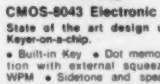
With two of these brackets you can bring the mobile rig into the house and use it in seconds. On trips you can take an AC supply for the rig and use it in your hotel room. Price: $29.95

400% MORE RF POWER
PLUGS BETWEEN YOUR MICROPHONE AND TRANSMITTER



$49.95

LSP-520BX. 30 db dynamic range IC log amp and 3 active filters give clean audio. RF protected. 9 V battery. 3 conductor, ⅛" phone jacks for input and output. 2-3/16 x 3-1/4 x 4 inches.



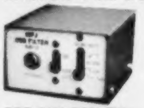
$59.95

LSP-520BX II. Same as LSP-520BX but in a beautiful 2-1/8 x 3-5/8 x 5-9/16 inch Ten-Tec enclosure with uncommitted 4 pin Mic jack, output cable, rotary function switch.

SUPER LOGARITHMIC SPEECH PROCESSOR

Up to 400% More RF Power is yours with this plug-in unit. Simply plug the MFJ Super Logarithmic Speech Processor between your microphone and transmitter and your voice is suddenly transformed from a whisper to a **Dynamic Output.**

Your signal is full of punch with power to slice through QRM and you go from barely readable to "solid copy OM."



$27.95

CWF-2BX Super CW Filter

By far the leader. Over 5000 in use. Razor sharp selectivity. 80 Hz bandwidth, extremely steep skirts. No ringing. Plugs between receiver and phones or connect between audio stage for speaker operation.

• Selectable BW: 80, 110, 180 Hz • 60 dB down one octave from center freq. of 750 Hz for 80 Hz BW • Reduces noise 15 dB • 9 V battery • 2-3/16 x 3-1/4 x 4 in. • CWF-2PC, wired PC board, $18.95 • CWF-2PCK, kit PC board $15.95

$49.95

CMOS-8043 Electronic Keyer

State of the art design uses CURTIS-8043 Keyer-on-a-chip.

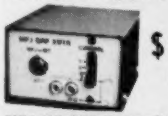
• Built-in Key • Dot memory • Iambic operation with external squeeze key • 8 to 50 WPM • Sidetone and speaker • Speed, volume, tone, weight controls • Ultra reliable solid state keying +300 volts max. • 4 position switch for TUNE, OFF, ON, SIDETONE OFF • Uses 4 penlight cells • 2-3/16 x 3-1/4 x 4 inches

39.95 NEW

MFJ-16010 Antenna Tuner

Now you can operate all band — 160 thru 10 Meters — with a single random wire and run your full transceiver power output — up to 200 watts RF power OUTPUT.

• Small enough to carry in your hip pocket, 2-3/16 x 3-1/4 x 4 inches • Matches low and high impedances by interchanging input and output • SO-239 coaxial connectors • Unique wide range, high performance, 12 position tapped inductor. Uses two stacked toroid core



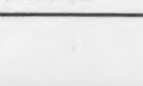
$15.95 NEW

CPO-555 Code Oscillator

**For the Newcomer to learn the Morse code.
For the Old Timer to polish his fist.
For the Code Instructor to teach his classes.**

• Send crisp clear code with plenty of volume for classroom use • Self contained speaker, volume, tone controls, aluminum cabinet • 9 V battery • Top quality U.S. construction • Uses 555 IC timer • 2-3/16 x 3-1/4 x 4 inches

TK-555, Optional Telegraph Key $1.95

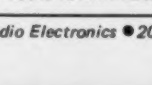


$29.95

SBF-2BX SSB Filter

Dramatically improves readability.

• Optimizes your audio to reduce sideband splatter, remove low and high pitched QRM, hiss, static crashes, background noise, 60 and 120 Hz hum • Reduces fatique during contest, DX, and ragchewing • Plugs between phones and receiver or connect between audio stage for speaker operation • Selectable bandwidth IC active audio filter • Uses 9 volt battery • 2-3/16 x 3-1/4 x 4 inches

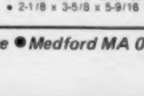


$27.95

MFJ-200BX Frequency Standard

Provides strong, precise markers every 100, 50, or 25 KHz well into VHF region.

• Exclusive circuitry suppresses all unwanted markers • Markers are **gated** for positive identification. CMOS IC's with transistor output. • No direct connection necessary • Uses 9 volt battery • Adjustable trimmer for zero beating to WWV • Switch selects 100, 50, 25 KHz or OFF • 2-3/16 x 3-1/4 x 4 inches



$49.95

MFJ-1030BX Receiver Preselector

Clearly copy weak unreadable signals (increases signal 3 to 5 "S" units).

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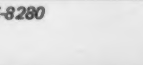

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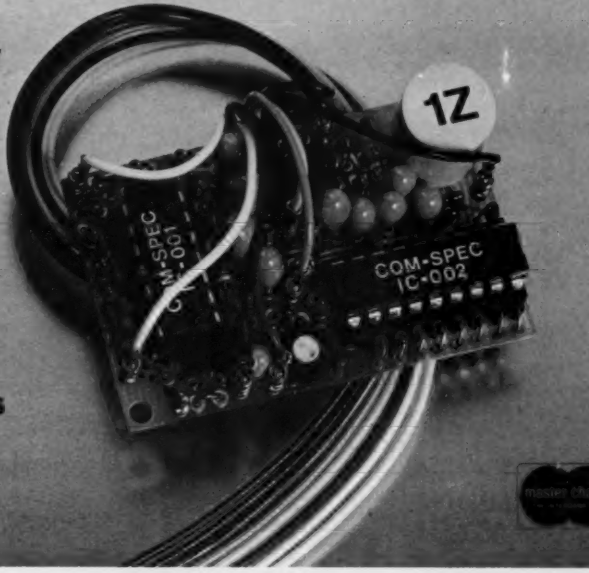

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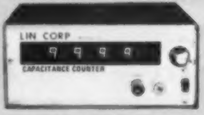

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146.16	146.64	146.97	147.30	147.84
146.19	146.67	147.00	147.33	147.87
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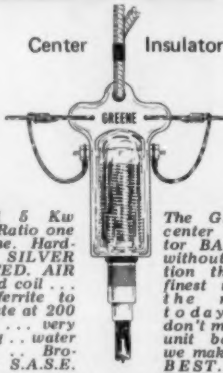

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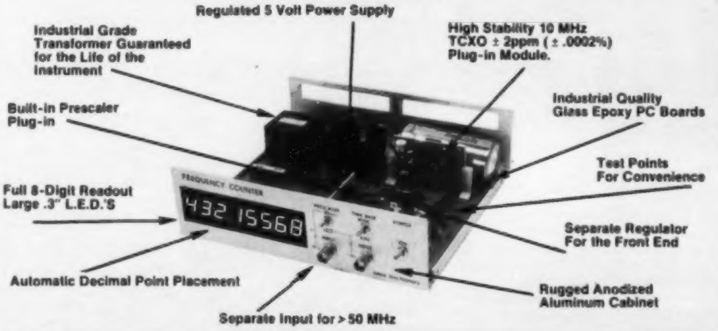
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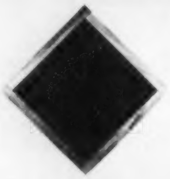

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I14

Looking West

from page 33

people like Ernie for the time spent updating us, and sincerely hope that this kind of information flow will continue.

As you are aware, part of the trip from here on was spent both SWLing CB and QSOing a "Ham Trucker" into Santa Barbara (on both CB and via two meters). It was not long after that, while listening on .28/.88, that the voice of Larry WA6OBT was heard on the Sulphur Mountain, Ventura County Repeater (WR6AOX). That meant that home was but an hour away. I hope that you enjoyed this trip along with us; maybe soon we can do it again. I can tell you that I will have some updated information this fall, since I intend to accept Ernie's invite and will definitely be at the Santa Maria Convention in October. I've heard that the barbecue is something to behold . . .

"73 AND 55"

"WA6ITF clear WR6BAX – 73 and 55, everyone." Something like that is being heard a lot out here these days on both HF and on our VHF repeaters. In fact, 55s are coming from as far to the west as Korea, according to Lenore Jensen W6NAZ. The Los Angeles Council of Radio Clubs, acting in cooperation with the California Highway Patrol, has hit upon a way in which amateurs can actively participate in a program designed to conserve two of this nation's most important natural resources: fuel and people.

When CHP Officer Dean Hirst came to my place of employment not long ago to speak on the subject of the Highway Patrol's renewed effort to motivate voluntary compliance with the national speed limit of 55 mph, and brought forth incontrovertible proof that the ten mile per hour reduction in the speed limit (from its previous 65 mph) had substantially lowered the number of fatal accidents in this state, it occurred to me that amateur radio might just be the proper vehicle to help spread the word. After all, the life saved might be yours, mine, or that of one of our loved ones.

A subsequent conversation with Officer Hirst led to an introduction to Southern California ARRL P.R.A. Lenore Jensen and to a meeting with the Los Angeles Council of Radio Clubs. Out of the final step has come a pledge that amateur radio operators will do all they can to adhere to the 55 mph limit and to help spread the word of the dual savings by ending QSOs with "73 and 55," thus signifying the individual pledge of voluntary compliance.

Whether you believe that there is a real energy crisis or are one of the skeptics is not important. The fact that the lower speed limit saves lives has been proven, and that in itself is more than enough reason for my own compliance with it.

How about you? Want to help make this a national movement within amateur radio? It's easy: just watch your speedometer and spread the word by using "73 and 55!"

55 = lives/fuel
AMATEUR RADIO
WAY PATROL

Officer Dean Hirst of the California Highway Patrol and Mary Ed Killitz WA6EJP of the San Fernando Valley Amateur Radio Club.

Social Events

SWIFT CURRENT SASKATCHEWAN JULY 2

There will be a hamfest held at Swift Current, Saskatchewan on July 2, 1977. For more info contact H. Bassendowske VE5PZ, 1433 Taylor Drive, Swift Current, Saskatchewan.

MILTON ONTARIO JULY 8-10

The Ontario Hamfest '77 will be held on July 8, 9 and 10, 1977, at the Milton Fairgrounds in Milton, Ontario. Program includes numerous commercial displays, giant flea market (no space charge), auction late Saturday afternoon, CW bingo, prizes and ham displays. Registration $4.50 adults; $3.00 children; children under 3 no charge. Registration after June 15 will be $5.00 for adults. All activities will be held inside in the event of rain. Talk-in station on 146.520 MHz simplex. For more information write Burlington Amateur Radio Club, PO 836, Burlington, Ont. L7R 3Y6.

OAK CREEK WI JULY 9

The South Milwaukee Amateur Radio Club Swapfest '77 will be held Saturday, July 9, 1977 at Shepard Park (American Legion Post #434), 9327 South Shepard Avenue, Oak Creek, Wisconsin. Activities begin at 7 am and will run until about 5 pm. Parking, picnic area, hot and cold sandwiches and liquid refreshments will be available on grounds. Overnite camping is available. Admission is $1 and includes a "Happy Hour" with free beverages. Prizes will be awarded. Talk-in on 146.94 MHz FM. More details (inc. map) from: South Milwaukee Amateur Radio Club Inc., S. F. Schreiter W9AKF, Sec., 104 Brookdale Drive, South Milwaukee WI 53172.

CUMMINGTON MA JULY 9-10

The Northern Berkshire Amateur Radio Club Hamfest will be held July 9th and 10th at the Cummington Fairgrounds, Cummington MA. Free overnight camping, tech talks, demos., and dealers. Flea market $1. Admission $3 with XYL $5, advanced $2 and $4. For information write Hildy Sheerin WA1ZNE, 79 Greylock Ter., Pittsfield MA 01201.

CHARLESTON SC JULY 9-10

The Charles Towne Hamfest, Charleston, South Carolina, will be held on July 9 and 10, 1977. Saturday, July 9th, the Charles Towne Hospitality Room will be at the Heart of Charleston Motor Inn starting at 7:30 pm. Sunday, July 10th, the flea market and swapfest will be at the Gaillard Municipal Auditorium starting at 8 am. Complete details by writing to: Charles Towne Hamfest Committee, Box 4555, Charleston Heights SC 29405.

INDIANAPOLIS IN JULY 10

The Sixth Annual Indianapolis Hamfest will be held on Sunday, July 10, 1977 at the Marion County Fairgrounds. There will be hourly prize drawings, a main prize drawing, a large indoor flea market, and a large outdoor flea market, forums, etc. Over 100 campsites are available. Forty with full hook-ups. Gate admission: $2. For more information write Indianapolis Hamfest, PO Box 1002, Indianapolis IN 46206.

BROOKLYN NY JULY 10

The Kings County Repeater Association of Brooklyn, New York, will hold its annual outdoor flea market (if rain – indoors) on Sunday, July 10, 1977, at 9 am to 4 pm. Located at 17 Eastern Parkway (at Grand Army Plaza), Brooklyn, New York. Sellers $6 per table, $3 half table, buyers $1. Refreshments available. Talk-in on 147.43, 146.43 and 52 direct. For further information contact WA2UMY (212) 941-8780.

SARATOGA UT JULY 16

The Utah Amateur Radio Club will hold its annual Utah hamfest and steak fry on July 16th at Saratoga resort. Bill of fare includes swap tables, CW contest, home brew contest, Oscar demo, women's activities, steak fry and many more ham games. Registration is $2 for UARC members, $5 for non-members and $1 for children under twelve. Registration includes choice steak, discount on rides, hot dog for kids, drawings and all other activities. Events begin at 9 am and run until after dark. Talk-in on repeater 16/76. For more information contact John Dehnel, c/o Utah Amateur Radio Club, 1547 Redondo, Salt Lake City UT 84105.

CORUNNA MI JULY 16-17

The Shiawassee Amateur Radio Association (SARA) is hosting the Buzzards Roost, Michigan Emergency, and Wolverine Nets picnic and SARA's 3rd Annual FREE Swap and Shop, Saturday and Sunday, July 16 and 17 at McCurdy Park in Corunna, Michigan just east of Owosso. Swap and Shop tables and trunk sale spaces available at $2.00 for 1 day and $3.00 for 2 days. Talk-in with W8QQQ on 3930 kHz, 146.52 MHz, 147.63/03 repeater, 449.3/442.1 MHz repeater. For a flier with a map and further information write: SARA, W8QQQ,

Continued on page 197

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Digital Clock Fail-Safe

- - so you won't miss the train

Honey, what time is 88:88:88?" "Oh, oh! You pulled the plug. Find out what time it is and I'll reset the clock." "Sorry I'm late, Boss. There must have been a power failure during the night and my electronic digital clock was talking garbage this morning." "Every time I close the transmitter key, that fool clock jumps two hours!" Situations sound familiar? Sure do, but this doesn't have to be. The fact is that of the three basic types of clocks, electrical, mechanical, or electronic, the latter is the one most easily made fail-safe. The trick is to get a little extra filtering in the normal ac to dc power supply and to provide a standby source of dc voltage and a 60 Hz (50 Hz) signal to keep the clock counting during a power outage.

For a clock built around the CT7001 or similar chip, there's no problem. Beef up the filtering a bit, add a backup battery supply with some diode switching, and let the built-in oscillator provide the counting signal. The ac/dc power supply shown in Fig. 1 should do the job nicely. For almost any other chip, however, an off chip oscillator has to be provided as well as the battery backup.

One way to generate the reference signal for the counting circuit is to use a precision crystal oscillator coupled with a suitable frequency dividing circuit. There are several ads in this magazine for just such circuits, prebuilt or in kit form. But if your clock is normally operated from the ac mains, the crystal oscillator is only the more expensive, not the best, approach to keeping reasonably accurate time. In the long run, the 60 Hz (50 Hz) signal provided by the power company should average out to a much more accurate count than will even a well-compensated crystal oscillator. It is possible to synchronize the crystal oscillator to the power company line frequency. However, this generally is not done in the known available kits and, even if it were, it would be an unnecessarily expensive solution.

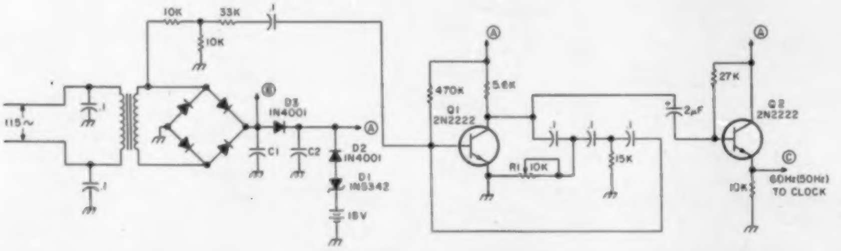

Fig. 1. Fail-safe power supply and clock count generator. Notes: 1. C1 = C2 = 200 to 300 uF, 25 volt; 2. D1, D2 – see text; 3. Adjust R1 for 50 or 60 Hz; 4. Point B to LED supply (see Fig. 2); 5. Resistors ¼ or ½ Watt, as available.

An alternative technical approach is shown in Fig. 1. It is considerably less expensive than the crystal oscillator/divider circuit and is inherently as accurate as the power company's line frequency whenever ac power is available. As long as the power company keeps furnishing the ac voltage, this oscillator will remain synchronized to the line frequency.

The circuit consists of an ac and backup battery power supply, some switching diodes to automatically engage the battery only when the ac voltage fails, and a phase-shift oscillator that will either synchronize with the line frequency or, during power outage, will provide a reasonably accurate signal to keep the clock counting. The "tickler" coming from the secondary of the power transformer to the base of Q1 serves to lock the oscillator to line frequency, working best when the resonant or free-running oscillator frequency is slightly low, even if ever so slightly. Only during a power outage will the resonant frequency of the oscillator determine clock accuracy.

Will the fact that the free-running oscillator is slightly slow cause much of a problem during power outage? Not really. Let's assume that it runs at 59.9 Hz and also that we have a reasonably long power outage, say four hours. The 0.1 Hz error translates to a 0.167% error, the clock losing 24 seconds during the power outage.

That shouldn't be upsetting in most cases.

Emitter follower, Q2, isolates the oscillator from the clock chip load and provides the necessary current sink. It, like Q1, is shown as a 2N2222. Actually, almost any small silicon NPN transistor will do either job. This looks like a great place to use some of those house-numbered transistors salvaged from a surplus board!

In the typical digital clock circuit, a signal is taken from the secondary of the power transformer, through a current limiting resistor (about 100k Ohms), to one of the clock IC's pins. A signal diode generally goes from that pin to the positive voltage supply. These components should not be removed. Simply cut the existing foil lead near the transformer secondary and solder a lead from the 60 Hz (50 Hz) output of the oscillator to the end of the current limiting resistor that formerly went to the transformer.

Providing a battery backup for the dc voltage to the clock chip may be a little more difficult on a previously assembled board than is coupling in of the timing signal. The actual complexity will vary from board to board, and all that can be said is, "It isn't really tough!" For new construction, whether using a "store bought" PC board or a "home brewed" one, it's probably best to use a separate board for the power supply and phase shift oscillator. If rebuilding an existing clock, it may be best to carefully salvage the power supply associated components from the old board and reuse them on a separate board. By the way, don't forget to remove the clock IC from the board while doing any soldering or unsoldering. It could save you the cost of a new chip!

Fig. 1 shows an 18 volt battery power supply made up of two 9 volt transistor radio batteries in series. The voltage is dropped 6.8 volts across a 1N5342 zener diode and another 0.6 or 0.7 volts through a 1N4001 before coupling to the ac power supply output (point A on Fig. 1). With the exception of the 1N4001 (or equivalent) diode that provides a switching function, nothing in the combination is critical. It is important only to have the battery-supplied voltage slightly below the normal ac-supplied voltage so as to prevent battery drain during normal operation.

Measure the dc voltage at the filter capacitor in your existing circuit. This will tend to fluctuate as the number of LED elements activated in the display changes. The highest value observed is the one of interest. From that value, subtract about 0.7 volts to account for the drop that will occur across diode D3. The battery voltage to be furnished to point A should be below the resultant figure and above the minimum operating voltage specified by the clock IC manufacturer. Within that range, any combination of batteries and voltage dropping diodes is satisfactory.

For example, the highest measured voltage at point A in the prototype was 12.5 volts. The clock chip specification called for an 11 volt minimum. Thus, any value between 11 and 12.5 volts would be satisfactory. The battery supply could have been made up of a 9 volt cell in series with two 1.5 volt cells with the zener eliminated. The actual circuit used was chosen because the zener was available and for ease in packaging the battery pack. Custom your package to fit your needs. Don't forget, however, that new cell terminal voltage for the 9 volt cell is about 9.4 volts and, for the 1.5 volt cell is 1.55 volts. If you cut your design too close, inadvertent drain of the battery supply during ac operation is possible.

The fail-safe circuit is designed so that, in principle, the LEDs will not display during battery operation. This is done deliberately to minimize battery drain. In some cases, however, the digits may be faintly displayed. This could occur with the circuit configuration shown in Fig. 2 if the LEDs are particularly efficient. The enabling current is base current flowing through the base of the NPN to the clock IC.

If your digital clock has an alarm clock feature and there happens to be a power outage at the instant the alarm should sound, the fail-safe circuit may or may not cause the alarm to function. It depends upon the design of the alarm feature. If there's an on- or off-chip oscillator, with or without an additional amplifier, driving a small speaker, the alarm buzzer can be made to function even though the time is not being displayed. It's necessary only to insure that power for the alarm circuit is tapped from point A and not from the LED supply bus. Obviously, if the clock functions to enable a radio-alarm, there won't be power available to play the radio, so . . . This does raise a good point, however. Should you have a radio-alarm, most likely the clock chip is driving a transistor which, in turn, pulls in a relay at the preset time. The relay can be a power hog. In order to protect the batteries, Vcc for the transistor that drives the relay should come from the LED supply bus.

The power supply of Fig. 1 has two filter capacitors, one on each side of diode D3. Capacitor C2 serves to further smooth the ac-supplied voltage against voltage transients. If the batteries are reasonably fresh, this capacitor isn't really necessary. It's most important as the batteries begin to age or are out of the circuit. It, like the zener diode, was a designer choice.

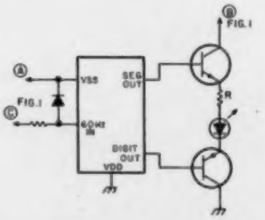

Fig. 2. Isolated LED supply and count in.

Calibration of the phase shift oscillator is most easily accomplished with the aid of an oscilloscope or frequency counter. With the latter, simply set the frequency to 59.9 Hz (49.9 Hz). For the scope, connect the vertical probe to the oscillator output, and the horizontal probe to the line frequency terminal on the scope or a similar 50 or 60 Hz source. Adjust R1 until a single ellipse (Lissajous pattern) appears. Then back off ever so slightly so that the pattern appears to be slowly rotating in a clockwise direction about an axis in the plane of the scope.

An alternative technique for calibration is with the sweep second hand of a watch or clock. Rig a temporary switch to enable and disable the ac line to the digital clock. Set the clock, turn power off for a period of 90 seconds, and switch power back on. Adjust R1 until the digital clock advances 90 seconds during the ac power off period. If, after a period of several days, the clock has gained time, tweak R1 to a slightly higher resistance. If the clock is four digit only, switch ac power off just as the minute digit changes. Delay 120 seconds and turn power back on. Adjust R1 so that, at first, the clock is running slow; the minute digit has not quite advanced again when power is reapplied. Gradually adjust R1 to decrease the error.

As the transformer used in the prototype was of the printed circuit board type, a simple PC board was used for the power supply and oscillator. It could otherwise just as well have been assembled on perfboard, vectorboard, or any other of the commonly used assembly techniques.

This simple fail-safe circuit works. Try it, you'll like it! ■

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Interest In Mail Order?

-- an insight into facts and myths

No, this isn't an article about setting up a mail-order business; rather, the subject is how you, as a consumer, can get the most benefit from mail order. As partner in an ad agency, I've had the opportunity to talk with several mail-order companies, and see how they work . . . from announcing a product to shipping out orders. You should know about some of the things I've learned in the process, as this information will help you get the satisfaction you deserve out of mail-order businesses. First of all, let's dispel two myths about the mail-order business:

Myth #1: Mail Order is Unreliable. This used to be true, especially in the days of patent medicines and sure cures for gout. Now, however, the competition is tough enough that no business can afford shady operation or unsatisfied customers. Additionally, new federal regulations — plus the severity of postal fraud charges — keep a watchful eye over mail order in general; and finally, magazines stop carrying advertising of those companies that inspire complaints to the magazine. A deadbeat company reflects negatively on the magazine that carries the advertising and makes life difficult for the legitimate operators.

How often do you get taken? Over the past eight years I've ordered something from just about every parts company that popped its head up over the horizon. The only problem I had was with a certain company that advertised surplus Switchcraft jacks and ended up sending me Japanese imports (worth far less than the jacks I ordered), and 6 months after I had sent my order, to boot! They cemented my unkind feelings by refusing to answer my letters. Six months later, no magazine was carrying their advertising, which confirmed my opinion was shared by others.

This is not to say you won't have problems; mail-order business employees have bad days, too, and dumb days, and sometimes they misplace an order or give you the wrong part. But these mistakes are forgivable; after all, we all make them.

Myth #2: Mail Order Can Sell Cheap Because There Is No Overhead. True, there is no store. But there are employees, ad budgets, rents on warehouse space, office space, city taxes, state taxes, bookkeeping, repair services, bank charges, insurance, social security payments . . . and the list goes on. But the important point for you to remember is that all of these have to be paid out of the customer's order. We'll see why this is important as we go along, since your actions can make a company operate more efficiently, and help keep costs down for you and other customers.

Ordering

First, order from *current* ads and catalogs. Prices fluctuate; some items are constantly going up, some are constantly going down (seen any $350 8080s lately?) Also, terms of sale sometimes change as a company changes, and there is no set policy on shipping, which varies from company to company. Sending in an order with not enough or too much money slows things down and increases expenses, and guess who ends up paying for it? So it may seem like a small thing, but courtesy dictates that you not send in for a special advertised in April two weeks before Christmas. If you want to find out whether an item is in stock, or if you want to check price, a phone call (remember the new 1 minute rates) or a post card if you're patient will do the job. And, of course, you can always circle the reader service cards in this and other magazines to keep abreast of the latest catalogs.

However, there will be times when you need more information about a product before making an informed buying decision. Again, write or phone the company, but take a few thoughts into account. Keep your questions as specific and to the point as possible; if you waste the time of the people at the company, they will not be able to do what they're paid to do — tend to the orders of paying customers. In fact, if the question you ask is specialized ("I have an antique Atwater Kent and would like to know if your part #45A3 is equivalent to their part #6543"), it is a nice gesture to include a self-addressed, stamped envelope, with your question written out, and a space for the answer. Then the company gets your request, scrawls an answer, and it's back in the mail the same day. Otherwise, the secretary has to be pulled off writing invoices to handle your request, then postage has to be affixed, the address double-checked, and so on. Remember that your requests are being paid for by the customers, so be considerate.

Now you know what to order. Next comes . . .

The Order Blank

First, make sure your

name and address are on the order! It really gets a company bothered to have an order for $76 worth of parts and no idea of where to send them, or who ordered them in the first place. In a case like that, the only hope is that the customer will write in and ask what happened to the order. Having your address on the check is not good enough, because most companies, when the mail comes in, verify that the amount of the check jibes with the order . . . at which point the check is immediately rushed to the bank to begin the clearing process, while the order moves on to the packing department. It is almost impossible for a large company to go back through a week's worth of checks to weed out one address. For similar reasons, if you have correspondence or questions that don't pertain to the order, put them on a separate piece of paper. That way your question will go to the technical service people, the order will get packed, and the check will get safely put in the bank.

Next, use the order blank the company provides; if that's not available, then type or print up your own, making sure you include 1) the name and/or stock number of the item desired; 2) the quantity you want; 3) a brief description of the item; 4) the subtotal for this item. If applicable, you might put acceptable substitutes on the line below. After you've listed all your items and prices, add the subtotals together and you're in business. If you need to add extra money, for insurance, handling charges, state tax, or whatever, list what it is, clearly. Don't just add on $2 and expect the company to know what you're doing it for. Is it tax? Or maybe you're ordering two catalogs. Be specific! When a packer is faced with dozens, maybe hundreds, of little pieces of paper in a day, each one of which must be perfectly packed – anything you can do to help speed things up is greatly appreciated. And that includes neat handwriting, too.

One way to make a company happy is to reference an ad if you're buying from an ad. Now I know people don't like to do this – sort of the "why should I help them, they're taking my money" attitude – but this is poor strategy, and here's why. Advertising is the *only* way a mail-order company can promote itself; there are no walk-in sales. And, advertising is not cheap. The money a company pays for ads has to come out of the profits generated by selling goods. A company with a good, effective, simple advertising program can sell for less and make more money if they know where their ads are doing the most good. This in turn keeps costs down for you. Money wasted on advertising that no one orders from only raises the prices of items you want.

The Postage Problem

In the semi-good old days, postage was cheap and the living was easy. Not so any more. The cost of postage, particularly for something heavy like a power supply, can turn a profitable product into a money sucker . . . which gets passed on to you. So, more and more companies are requesting postage or just tack on a straight percentage to cover postage and handling. This brings up a pet peeve of mine: the credit slip. Luckily, these do seem to be dying a slow death, and, unless the amount is very small, most companies will write a refund check if you include too much money for postage. If you get a credit slip, you can always request a check and send back the slip. Xerox your letter and credit slip, though, just in case there are any problems.

More and more companies are relying on UPS to ship their packages. This generally gives better service than the PO, but remember that UPS goes to your house and needs a street address. They cannot deliver to a post office box, unless, of course, you happen to live in one (cramped quarters, but cheap rent). If you do not include a street address, there will be delays: First UPS has to check with the post office to see if you have a local street address; then they send out a notice that informs you that you need to call UPS and complete arrangements for the delivery of the package. Save time and hassle – include your street address and PO box if you have one (for the mailing list).

There is an easy way to find out exact postage charges. Let's say you're ordering a 10 pound widget from a company in Florida, and you live in Ohio, and the widget is being sent via UPS. Just call up your local UPS and ask them how much it would cost to send a 10 pound widget to Florida from Ohio. It costs the same whether a package goes from point A to point B, or from point B to point A.

Minimum Orders

Here is what appears to be a classic example of screwing the little guy, or at least that's what I always thought. But look at it from the company's point of view, and from yours . . . it only takes a little more time to pack a $200 order than a $2 order. Let's say it takes 30 minutes total to process a single order. This comes out to at least $1.50 worth of labor at today's wages. So in the case of the $200 order, there's enough profit to pay for the cost of the processing. But with a $2 order, the company may actually lose money. A company that loses money has to make up the difference somewhere, and that difference comes out of the pockets of customers. To help defray this, most companies tack on a service charge for orders under a certain amount. It's a drag, I know; there have been many times I wanted to buy a single IC, only to find out it would be cheaper to buy ten. But you can't really blame the companies, at least not until people are willing to pack orders for free. Meeting minimum orders keeps the cost down for everybody.

Complaints

Eventually you may have to complain about something. But before you do, simmer down for a second and look at the situation objectively. People are only human, and mistakes do occur. Before you assume that a company is out to do you in, give them the benefit of the doubt. Letters do get lost or misplaced; water can spill on an order and make the ink run to the point of illegibility; handwriting can be undecipherable; in short, Murphy's Law is no stranger to the mail-order biz. Or maybe the product that was scheduled to be shipped January 1 is missing two ICs, which were promised by the supplier to arrive in November and finally show up in March. Be sympathetic. The object of a complaint is not to vent your spleen, or to take your aggressions out on some poor clerk, but to get a problem resolved. Don't accuse someone of dishonesty when their only crime may be ignorance or carelessness. It happens to all of us. First time, state your problem clearly and unemotionally; ask for their explanation. But – and this is an important but – although the odds are against it, you may be dealing with a thief. If you make a complaint, make at least two copies of your correspondence in case you need to complain again to the company or the authorities. If you don't get any action after two or three weeks (which should be enough time for the company to answer you), your next letter should be a little less courteous. Mention the date of the previous correspondence, and show them you've been patient. My father taught me an almost foolproof way of getting answers from people who don't answer the first letter: Take a carbon copy (this is why you make two copies), and write across it, in the biggest letters possible, DON'T YOU ANSWER YOUR MAIL? It gets results.

But if it doesn't . . . the company has two strikes against it. Now comes your "last straw" letter. Document your previous attempts (" . . . there was no reply to my letter of October 2 or November 15 . . . ") and get mad; you've earned it. Send a carbon to the magazine handling their ads, the Better Business Bureau, and possibly someone at consumer affairs in their state government. By the way, you can almost always get a street address for a business from a magazine that carries their advertising; they can't hide behind a PO box anymore. Don't forget the action line of local papers, too; although they may not be able to help in your specific case, they can refer you to the proper authorities.

Postal fraud is a very serious federal offense, and if you can't get satisfaction after all this pressure, it's time to get the government into the act. No doubt some young, hungry bureaucrat would love to sink his or her teeth into a nice fraud conviction. Just make sure you're right before you get heavy.

Repairs

From time to time you'll get a kit or a finished product that either doesn't work or doesn't come up to spec. The problem may be at your end or the company's; you won't know for sure until they've looked at it. So don't assume the design is lousy, or that the company is putting out a piece of garbage: You could have a cold solder joint, or the company's supplier may have slipped them a bad component, or anything. When dealing with a repair, first check the unit over thoroughly yourself, preferably on two different days and with a friend who also is familiar with electronics. Sometimes unfamiliarity with a unit prevents getting good results; how can you set up a unit to do something when you aren't quite sure what it's supposed to do? I run into this problem sometimes with the musical modifiers I design; people don't know what it's supposed to sound like, so if there's a bum IC and a distorted sound, they might assume the distortion is part of the effect. Sometimes a phone call to the tech person at the company is all that's needed; sometimes a letter, carefully describing the problem, can save you having to return the unit. So, always write the company before returning something. This isn't just to find out if others have had the same problem – sometimes a company will move and your package can end up in post office limbo; sometimes a company has a separate repair facility, and you could save time by sending your problem child directly to the repair facility. Also, a prior notification alerts the company to watch for your unit.

No company gets rich on repairs; one company I know has yet to charge for any repairs it has done, even those which were the customer's fault. They do enough business, and have a low enough rate of returns, that they can afford to do this. But not all companies can be that generous, especially when asked to repair a problem they didn't cause (bad wiring or soldering, for example). In many of these cases, if the builder, upon receiving the kit, had simply looked at it, recognized it as being beyond his ability, and returned it unbuilt, he could have gotten a full refund. But to botch a kit and then expect the poor company to make good – for free – is too much, and people can expect to pay for their mistakes. This isn't real good for their pride, maybe, but I have seen some genius computer programmers do lousy soldering jobs. If you're new to kits, start with something simple, then move on to the heavy stuff. Until then, buy your units assembled if you have doubts about your abilities. In many cases, the manufactured units also have more extensive warranties.

When you return the kit, pack it well. You don't want things to go from bad to worse in transit. Also, get a self-stick label and put your name and address on the piece of equipment itself (you won't regret it). Include in the package a thorough description of the problem, along with copies of any pertinent letters (don't say "this is a kludge"; be specific). You can save a repair technician lots of time by relating your experiences with the unit. In your letter, you might also mention that if repair costs are more than a certain amount (whatever you are willing to spend and feel is reasonable), to please notify you by post card. This way, if there is some really bad problem, you won't get any surprises. If it's any consolation, the companies I have seen are conscientious about repairs. Just as word of mouth is the best advertising, a non-working product is the worst. Plus, a company can gain respect by handling repairs in a prompt and intelligent fashion.

Summing Up

So far we've talked about all the things that can go wrong, and the nightmares that a mail-order operator or customer may confront. Lest you get the wrong idea, just as the majority of companies are ethical, so are the customers. Most are courteous, patient, decent people who trust the companies and have that trust confirmed by a company that acts likewise. Businesses are truly grateful for their customers, and frequently recognize the names of repeat customers. The point is that even the biggest companies are run by people; you're not dealing with nameless automatons at the other end. So you should know that your patronage is valued, and enjoyed, and they want to keep you as a customer. In this respect, you owe them one favor. If a company does something that leaves you feeling let down – whether it's a part that doesn't meet spec, a delivery commitment that isn't kept, or a kit that doesn't seem to work right – let the company know. Don't just write it off; you may be writing off something whose only problem is a hairline short on a circuit board. If it is a problem at the company's end (like a design flaw that only shows up under certain conditions), they *need* to know about it. Otherwise, they can send out hundreds of the things before someone says something and the error gets corrected. Companies do extensive prototyping, but even then, you can't cover all circumstances of operation. So if you're disappointed, speak up! But remember, you're writing to someone with feelings. Don't just say something is a piece of garbage; be specific, constructive, and objective. You will be doing everybody a favor . . . it's feedback for the company, an elimination of the problem for future buyers, and you've made a contribution.

I hope that all the preceding will help you get the most out of mail-order companies. I buy almost all my parts that way. I've had some bummers, but none that the company wasn't willing to make good (usually with profuse apologies). Treat them like human beings, and you'll be treated likewise. Help them a little bit by following these tips, and you'll simultaneously keep the costs down for yourself and fellow mad scientists . . . and score quite a few bargains in the process. ■

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EDITORIAL BY WAYNE GREEN

from page 4

have a row of LEDs on the rim of the mug spelling out "HOT"?

If I were doing it, I would make up a sample and get it working right, then I'd see about a small firm to make them for me, and I'd start out selling them through the mail-order houses. Once you get going, you can start distributing them in department stores, discount houses, and you will be a millionaire and have ten times as many problems as you do now . . . just different.

The HOT MUGGER will adapt to the car too, plugging into the cigarette lighter. You will have your executive models for modern desks, a group model for restaurant tables . . . it'll hold four cups at a time. It'll work as well for hot chocolate, soups, etc. Then comes the deluxe model with the adjustable thermostat so you can cook the soup right in the cup and then keep it warm, but not boiling, after it is done.

Only one thing . . . if you do make it big with the HOT MUGGER, I'd appreciate your building in a 5% royalty for me . . . for what's left of my old age.

ELECTRONIC ART

Twice recently, I've seen some good examples of the use of electronic circuits as art forms . . . one using LEDs and the other using NE-2s as part of the art.

For instance, The Electron Art Company is turning out framed and mounted circuits which blink neon lamps. The resistors and capacitors which make up the circuit are part of the art. The battery is built into the back of the picture.

Why not put your imagination to work and see what you can come up with? You have circuit elements to work with . . . LEDs of various colors . . . neon lamps . . . if nothing else you may come up with a winner for a *73* cover. Those electron art "pictures" are selling for around $18 for an 8 x 10 and $50 for a 16 x 20, so you might be able to get a small business going. Christmas isn't that far away.

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27K ohm
33K ohm
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4 digit counter/latch decoder; 7 segment output only. 24 pin dip with specs.

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Kit Includes: 12 digit display .4" Character Power supply for display above Complete specs for hookup.

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Telephone Relay automatically starts and stops tape recorder. No batteries required. Kit complete with drilled P.C. Board.

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*Continously variable from 5V to 20V
*Excellent regulation up to 500 mil.
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*One hour assembly
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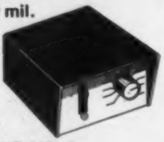

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Same as above but with 1 amp output, also with case.

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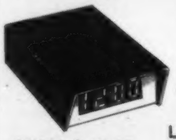
CLOCK KIT



Kit includes

- LT701 clock module
- Power Supply
- Punched Case
- 12 or 24 hour operation

Complete except for line cord

LT701E 12 hour clock

ONLY $ 14.95

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Standard 9V battery clip with 4-1/2" tinned leads. 25/$1.00

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2N2222	6/1.00
2N2369	6/1.00
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D40C1 Power Darl – 8/1.00

*House numbered and P.C. Lead

PC BOARDS

4 digit PCB for FND800 or 807	2.50
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NOTE: All PC Boards are multiplexed for adding additional digits.

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New, includes 2-56, 4-40, 6-32 and 8-32 screws and nuts. A very usable selection.

½ pound $1.50
1 pound $2.60

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7400	.17	7473	.21
7401	.17	7474	.35
7402	.17	7475	.55
7403	.17	7476	.35
74H04	.25	7480	.45
7404	.17	7483	.76
7406	.25	7485	.89
7408	.17	7486	.35
7409	.17	7490	.71
7410	.17	7491	.71
7411	.25	7492	.71
7413	.45	7493	.67
7420	.17	7494	.90
7421	.17	7495	.71
7423	.35	7496	.85
7425	.27	74100	.96
7426	.25	74121	.31
7427	.17	74123	.61
7430	.25	74125	.44
7432	.30	74141	.71
7437	.35	74145	.97
7438	.35	74151	.71
7440	.17	74153	.81
7442	.60	74154	.97
7443	.60	74161	.91
7444	.65	74163	1.05
7446	.85	74164	1.05
7447	.81	74174	.91
7448	.81	74175	1.40
7450	.20	74180	.76
7451	.17	74181	2.25
7453	.17	74191	1,20
7454	.17	74192	1.20
7470	.35	74193	.95
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60 Hz ═ L(•)(•)K ═

Crystal Time Base Kit – Kit enables a MOS clock circuit to operate from a DC power source. Ideal for car, camper, van, boat, etc.

60Hz output with an accuracy of .005% (typ.) Low power consumption 2.5 ma (typ.). Small size will fit most any enclosure. Single MOS IC oscillator/divider chip 5-15 volts DC operation.

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74LS10	.25
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74LS20	.31
74LS21	.33
74LS22	.33
74LS27	.30
74LS30	.31
74LS32	.33
74LS37	.40
74LS38	.35
74LS74	.49
74LS90	.85
74LS132	.90
74LS138	.89
74LS139	.89
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74LS157	1.00
74LS162	1.39
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CD4010	.45	CD4047	.59
CD4011	.16	CD4049	.35
CD4012	.16	CD4050	.35
CD4013	.29	CD4051	.90
CD4014	.75	CD4053	.90
CD4015	.75	CD4056	1.00
CD4016	.29	CD4058	.90
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2. Our famous 2M converters (below) allow you to build up an inexpensive receiving system for mode B. (10 meter i-f recommended.)
3. Popular 10 meter preamps bring new life to your receiver for mode A reception.
4. We have a large stock of the rugged CushCraft beams for immediate delivery, including these popular models recommended for OSCAR. Give us a call; we'll ship yours right away!
5. We stock CDR rotors, low loss cable, etc. Give us a call!

Model	Type	Price
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A147-4	4 el 2m End Mount Beam	19.95
A147-11	11 el 2m Beam	29.95
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A147-20T	10 el FM/10 el SSB	54.95
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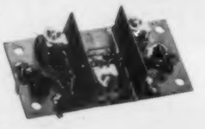
P8 KIT $7.95 P16 W/T $16.95

MODEL	RANGE
P8-30	20-83 MHz
P8-150	83-190 MHz
P16-	Give exact freq.

- Easy-to-tune cascade circuit
- 20-30 dB gain; 2.5 dB noise figure
- Fits in transceivers, only 1/2 x 2-3/8"

P15 KIT $15.95 P35 W/T $34.95



- 2 common gate fet's
- 20 dB gain; 4.5 dB noise figure
- Great for atv ssb, fm

Available for any band 380-520 MHz

P9 KIT $9.95 P14 W/T $19.95

MODEL	RANGE
P9-30	26-88 MHz
P9-150	88-172 MHz
P9-220	172-230 MHz
P14	Give exact freq.

- 2-stage common gate fet ckt
- 20-30 dB gain; 2 dB noise figure
- Compact – 1½ x 3"
- Coax connectors & diode protection
- Great for OSCAR!

FM/CW TRANSMITTER KITS

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- USE ON CW FOR OSCAR!
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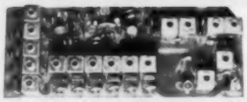
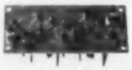
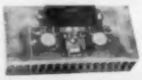




T20 Tripler/Driver Module Kit, 150 mW 2M input, 200 mW 450 MHz output $19.95



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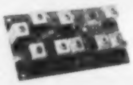

MODEL C25 VHF CONVERTER KIT (shown) $25.95
● Models for 2M, 6M, 10M, 220 MHz, aircraft, com'l, etc. ● Stable cascade rf stage ● 0.3-0.5 uv sensitivity ● 10-20 dB gain ● Compact 2½ x 4½" pcb ● Any i-f 10-50 MHz

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● For 432 MHz ssb or atv, 450 MHz fm, aircraft or com'l, etc. ● Economy Converter ● Use with P15 Preamp for Optimum Performance ● Any i-f 10-160 MHz

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Contain probe, ground clip, cable, and all components except plug to mate with your test equipment.

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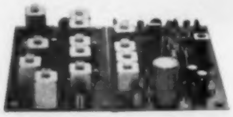

VHF MODELS FOR ANY BAND 28-240 MHz
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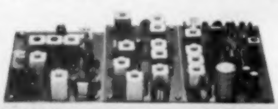

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A great new line of power supplies to operate 12vdc gear in the shack or shop! All have low ripple, good regulation, and overload protection. And they are all in STOCK for IMMEDIATE DELIVERY, and they are all WIRED & TESTED.

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*Indicate model which has panel meter(s)

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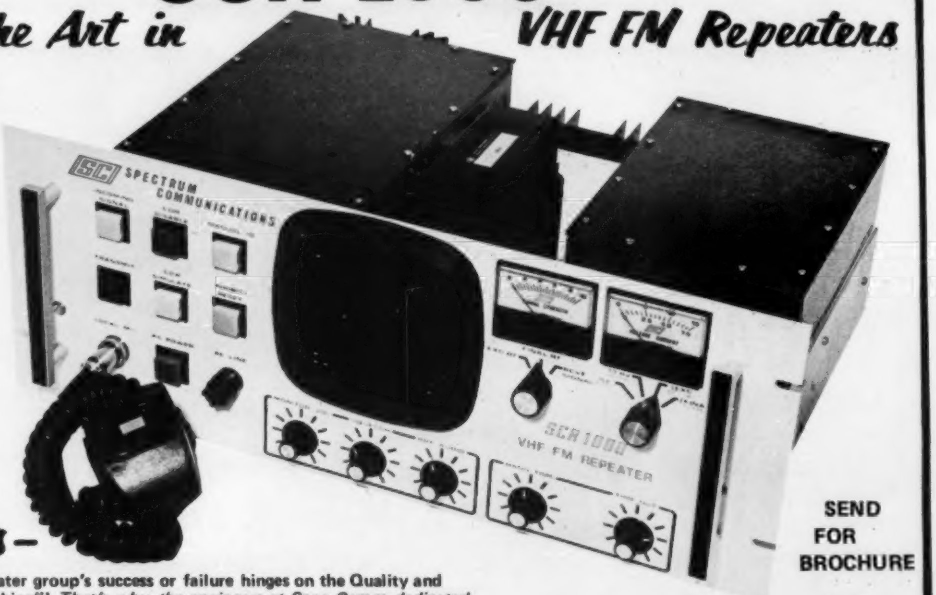
H16

SCR 1000

State of the Art in VHF FM Repeaters

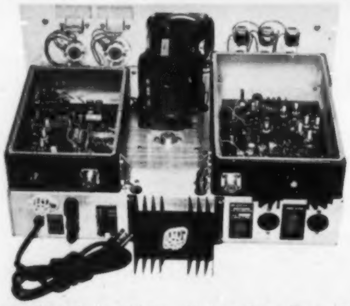


SEND FOR BROCHURE

Some Plain Talk About Repeaters–

Let's face it — your repeater group's success or failure hinges on the Quality and Reliability of your "Machine"! *That's why the engineers at Spec Comm dedicated themselves to the production of the finest repeater available on the amateur market.* The SCR1000 has been conservatively designed for years of trouble-free operation, and every consideration has been given to operator convenience and accessory interfacing. Features like full metering, lighted status indicators, full front panel control of every important repeater operating parameter, and accessory jacks for autopatch, xmtr. remote control, etc. And audio so good and so full, your 30 watts will sound like 100! Think about it, and think about your users. ***The purchase of a Spec Comm Repeater is a sound investment in your group's future,*** and they'll be thanking you for years to come. Sold Factory Direct only. $899.95.

Don't make a mistake — your group deserves the finest!



Custom 'Mods' Available: 'PL', 8 Pole Rcvr. Filter, Hi/Lo Power, Multi-Freq., etc. — Inquire.

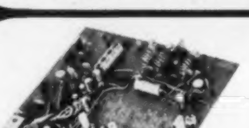
Specifications

RF Output . . . . .30 Watts
Infinite VSWR proof
Sensitivity . . . . . 0.3uV/20dB Qt.
Selectivity . . . . -6dB @ ±6.5 kHz;
-58dB @ ±15 kHz;
-90dB @ ±30 kHz.
(Sharper 8 Pole Fltr. Available)
Desense/Overload . . . W/1uV desired signal, desense just begins @ approx. 50,000uV @ ±600kHz.
Spurious Response . . . -70dB min.

FEATURES

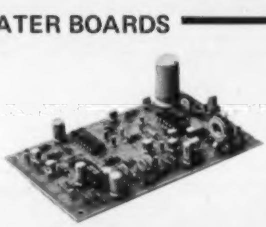
☐ **Full Metering** of critical levels.
☐ **Front Panel** Controls for timers & AF levels.
☐ **Lighted push-buttons** for control/test functions & status indicators
☐ **State of the Art CMOS** control logic & timers — No Relays!
☐ **Built-in IDer** — field programmable. Fully adjustable speed, pitch, time, etc.
☐ **Exclusive Spec Comm MOSFET/Hot Carrier Diode** rcvr. front end — greatly reduces 'desense' & IM problems!
☐ **Built-in AC Supply** w/instant btry. switchover for emergency pwr.
☐ **Supplied with .0005% Sentry xtals** and a **Turner** local mic.
☐ **Jacks Provided** for Remote Control, Auto-Patch, DC out, AF in/out, COR Switch, etc.
☐ **True FM** — ***For Rpt. Audio so good, it "sounds like direct"!***

SPEC COMM REPEATER BOARDS

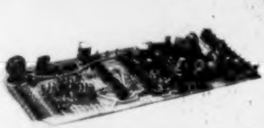


SCR100 Receiver Board
- Ext. wide dynamic range! Greatly reduces overload, 'desense', and IM.
- Sens. 0.3uV/20dB Qt.
- Sel. -6dB @ ±6.5KHz; -90dB @ ±30KHz, (-110dB w/opt. 8 Pole Fltr.)
- Exc. audio quality! $115.00 w/xtal, Asmbld. & Tested

SCT 100 Xmtr/Exciter Board
- 5-6 Wts. Output
- Infinite VSWR proof
- True FM for exc. audio quality
- Spurious -60dB
- With .0005% xtal. $115.00 Asmbld. & Tested. BA-10 30 Wt. Amp Board & Heat Sink. 3 sec. LPF & rel. pwr. sensor. $51.95 Asmbld. & Tested



CTC100 COR/Timer/Control Board
- Complete COR circuitry
- Carrier 'Hang' & T.O. Timers
- Remote xmtr. control
- 100% Solid State
- Many other features
$32.95 Asmbld. & Tested



ID100 ID & Audio Mixer Board
- 100 bit diode programmable memory
- Adjustable ID tone, speed, level, time
- 4 Input AF Mixer & Local Mic amp
- COR input & xmtr. hold
- All CMOS logic
- Many other features
$59.95 Asmbld. & Tested

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NEW!
FM144-10SXRII

KDK

All Solid State-PLL digital synthesized — No Crystals to buy! 5KHz steps — 144–149 MHz-LED digital readout PLUS MARS-CAP.*

• 5MHz Band Coverage — 1000 Channels (instead of the usual 2MHz to 4MHz — 400 to 800 Channels) • Priority Channel • Audio Output 4 Watts • 15 Watts Output • Unequaled Receiver Sensitivity and Selectivity — 15 POLE FILTER, MONOLITHIC CRYSTAL FILTER AND AUTOMATIC TUNED RECEIVER FRONT END — COMPARE!! • Superb Engineering and Superior Commercial Avionics Grade Quality and Construction Second to None at ANY PRICE.

- **FREQUENCY RANGE:** Receive: 144.00 to 148.995 MHz, 5KHz steps (1000 channels). Transmit 144.00 to 148.995 MHz, 5KHz steps (1000 channels) + MARS-CAP.*
- **FULL DIGITAL READOUT:** Six easy to read LED digits provide direct frequency readout assuring accurate and simple selection of operating frequency.
- **AIRCRAFT TYPE FREQUENCY SELECTOR:** Large and small coaxially mounted knobs select 100KHz and 10KHz steps respectively. Switches click-stopped with a home position facilitate frequency changing without need to view LED'S while driving and provides the sightless amateur with full Braille dial as standard equipment.
- **FULL AUTOMATIC TUNING OF RECEIVER FRONT END:** DC output of PLL fed to varactor diodes in all front end R-F tuned circuits provides full sensitivity and optimum intermodulation rejection over the entire band. **No other amateur unit at any price** has this feature which is found in only the most sophisticated and expensive aircraft and commercial transceivers.
- **TRUE FM:** Not phase modulation — for superb emphasized hi-fi audio quality second to none.
- **FULLY REGULATED INTEGRAL POWER SUPPLIES:** Operating voltage for all circuits, i.e., 12v, 9v and 5v have independently regulated supplies. 12v regulator effective in keeping engine alternator noises out and protects final transistor from overload.
- **MONITOR LAMPS:** 2 LED'S on front panel indicate (1) incoming signal-channel busy, and (2) un-lock condition of phase locked loop.
- **DUPLEX FREQUENCY OFFSET:** 600KHz **plus** or **minus**, 5KHz steps. Plus simplex, any frequency.
- **MODULAR COMMERCIAL GRADE CONSTRUCTION:** 6 unitized modules eliminate stray coupling and facilitate ease of maintenance.
- **ACCESSORY SOCKET:** Fully wired for touch-tone, phone patch, and other accessories.
- **RECEIVE:** .25 uv sensitivity. **15 pole filter** as well as monolithic crystal filter and **automatic tuned** LC circuits provide superior skirt selectivity.
- **AUDIO OUTPUT: 4 WATTS.** Built in speaker.
- **HIGH/LOW POWER OUTPUT:** 15 watts and 1 watt, switch selected. Low power may be adjusted anywhere between 1 watt and 15 watts, fully protected — short or open SWR.
- **PRIORITY CHANNEL:** Instant selection by front panel switch. Diode matrix may be owner re-programmed to any frequency (146.52 provided).
- **DUAL METER:** Provides "S" reading on receive and power out on transmit.
- **OTHER FEATURES:** Dynamic microphone, mobile mount, external speaker jack, and much, much, more. Size: 2⅛ x 6½ x 7½. All cords, plugs, fuses, mobile mount, microphone hanger, etc., included. Weight: 5 lbs.

NEW! 6 METER FM50-10SXRII

Same specifications as above except transmit/receive: 51.00-53.995 MHz. 600 channels
Introductory Price $389.00

146.000
FM
RPTU
SIMP
RPTD
MIC

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FM144-10SXRII
$389⁰⁰
VALUE $599.00

Regulated AC/PS
Model FMPS-4R . . . $49.00

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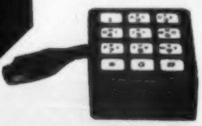
TONE ENCODER/ DECODER

SC-12A . . . 12 CHANNELS . . . DUAL TONE
Introductory Price $119.00



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MODEL FMTP-1
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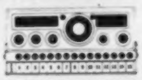
NEW!
FMSC-2 SCANNER
FOR KDK
FM-144



14 CHANNEL PROGRAMABLE
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PLEASE WRITE FOR COMPLETE INFORMATION.

NEW AM/FM ANALYZER

SIGMA
AF-250L

- INTRODUCTORY PRICE $199
- DEVIATION/MODULATION METER - FM: 0-20 KHz, AM: 0-100%.
- SIZE: 5½"(h) x 10¼"(w) x 7¼"(d). WEIGHT: 7 lbs.
- FREQUENCY: 1.8MHz-520MHz

ALSO MODEL AF-251LW WITH BUILT IN 125 WATT CALIBRATED WATT METER & DUMMY LOAD. PRICE $289
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NEW 2 METER FM
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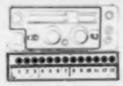
REGULAR	$384.00
OUR PRICE	**$279.00**

NEW!! TOUCH TONE PAD
COMPLETELY WIRED &
READY TO PLUG IN $69.00

NEW! 7400 SCANNER

FOR
KENWOOD
TR-7400A



14 CHANNEL PROGRAMABLE
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STANDARD
TRANSCEIVER
MODEL SRC-146A

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COMPLETELY WIRED &
READY TO PLUG IN $69.00
COMPLETE BACK ASSEMBLY

NEW! TWO NEW SCANNERS!
FMSC-1 SCANNER FOR KDK FM 144 **AND**
7400 SCANNER II for Trio-Kenwood TR-7400A

FMSC-1 SCANNER	**$169**
7400 SCANNER II	**$189**

- Full scan 146 and 147 MHz consecutively or 1 MHz, or any MHz range
- Scan rate: 1 MHz/2 seconds (adjustable)
- Controls: Scan/Hold, Latch/Delay, 600 KHz offset (off, up, down), program/1 MHz
- Simple installation.

NEW— COR HAM II ROTATORS Reg. $159.95 $125.00

the indispensable BIRD 43
THRULINE WATTMETER

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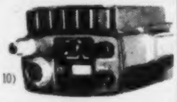

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5 CHANS (TOTAL 10)
TO SRC-146A

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- Same color and quality as SRC-146A
- Completely WIRED & TESTED
- ALSO usable with most other hand helds $39.95

YAESU FT-101E
TRANSCEIVER'S
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SWR &
POWER METER

INTRODUCTORY PRICE **$29**
CAL. PWR. SCALES 200W/2000W
- FREQ. RANGE 3.5 - 150 MHz
- PLEASE DO NOT CONFUSE THE RF 2000 WITH SIMILAR APPEARING LOWER PRICED UNITS – RF 2000 IS AN INDIVIDUALLY CALIBRATED PROFESSIONAL QUALITY INSTRUMENT –

UNEQUALED AT MANY TIMES THE PRICE.

SIZE:
7"(w) x 2½"(h)
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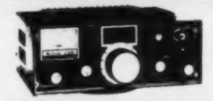

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210X-215X AND 350-XL

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LINEAR
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INTRODUCTORY PRICE **$789**

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- 2000 + WATTS P.E.P. SSB INPUT. 1000 WATTS INPUT CONTINUOUS DUTY, CW, RTTY AND SSTV.
- TWO EIMAC 3-500Z CONSERVATIVELY RATED FINALS.
- ALL MAJOR HV AND OTHER CIRCUIT COMPONENTS MOUNTED ON SINGLE G-10 GLASS PLUG IN BOARD. HAVE A SERVICE PROBLEM? (VERY UNLIKELY) JUST UNPLUG BOARD AND SEND TO US.
- HEAVY DUTY COMMERCIAL GRADE QUALITY AND CONSTRUCTION SECOND TO **NO OTHER UNIT AT ANY PRICE!**
- WEIGHT: 90 lbs. SIZE: 9½"(h) x 16"(w) x 15¾"(d).

FEATURES

CUSTOM COMPUTER GRADE COMMERCIAL COMPONENTS, CAPACITORS, AND TUBE SOCKETS MANUFACTURED ESPECIALLY FOR HIGH POWER USE — HEAVY DUTY 10KW SILVER PLATED CERAMIC BAND SWITCHES • SILVER PLATED COPPER TUBING TANK COIL • HUGH 4" EASY TO READ METERS — MEASURE PLATE CURRENT, HIGH VOLTAGE, GRID CURRENT, AND RELATIVE RF OUTPUT • CONTINUOUS DUTY POWER SUPPLY BUILT IN • STATE OF THE ART ZENER DIODE STANDBY AND OPERATING BIAS PROVIDES REDUCED IDLING CURRENT AND GREATER OUTPUT EFFICIENCY • BUILT IN HUM FREE DC HEAVY DUTY ANTENNA CHANGE-OVER RELAYS • AC INPUT 110V OR 220V AC, 50-60Hz • TUNED INPUT CIRCUITS • ALC-REAR PANEL CONNECTIONS FOR ALC OUTPUT TO EXCITER AND FOR RELAY CONTROL • DOUBLE INTERNAL SHIELDING OF ALL RF ENCLOSURES • HEAVY DUTY CHASSIS AND CABINET CONSTRUCTION AND MUCH, MUCH MORE.

AMMCOM

S 2 25 TWO METER
SYNTHESIZED VHF-FM
TRANCEIVER

NEW!

- 25 watts output
- 600 kHz and 1 MHz offsets built in
- Please write for complete information and **SPECIAL INTRODUCTORY PACKAGE PRICE**

KDK

ACCESSORIES FOR KDK FM 144

FMPS-4R	Regulated AC/PS	$49
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FMTP-2	Touch Tone Pad with 10 Number Programable Memory	$99
FMMC-1	Microphone with Built-in Touch Tone Pad	$59
FMTD-1	Private Call Decoder for use with and Programed by Any Touch Tone Pad	$129
SC-12A	Audible Tone Encoder Decoder	$119
FMSC-1	Scanner — Random, Any Range	$169
FMSC-2	Scanner — Programable, 14 Channels	$99
MARS CAP®	Option Kit — Any Frequency, Any Split	$12
FMOF-1	Offset Option Kit — 2 Extra Positions, Crystals Required	$19
FMOF-2	±1 MHz Offset Option Kit (No Crystals To Buy)	$19
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Service Manual		$2.00
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A21

NEW

DIGITAL CLOCK with 10 MINUTE TIMER

6 digits – 12/24 hour

Here's the kit everyone has been asking for! Never fail to identify your station again. And it's easy to use, just tap timer button to start, 9 minutes later the display will flash on and off to alert you. Reset it by simply touching the timer button or it will reset itself automatically after two minutes! Other features are: jumbo .4" LED readouts, durable extruded aluminum case available in 5 colors, plug transformer, Polaroid lens filter, time set buttons, finest quality PC boards and super instructions. You get all parts – no extras are needed, unlike some of the kludges our competitors offer! Colors available: gold, black, silver, bronze, blue (specify). Size: 4.25" x 1.5" x 1.5".

Clock Kit with 10 min. timer, DC-10 .... $25.95
Regular 12/24 hr clock kit 22.95
Alarm clock, 12 hr only, DC-8 .... 24.95
Kits are also available fully assembled and tested, just add $10 to kit price.

CAR CLOCK 6 DIGIT 12/24 HR $25.95

- High accuracy (1 minute/month)
- Big .4" LED display
- Special circuit suppress all voltage spikes and transients
- Same case as illustrated above
- Display blanks with ignition off
- Reverse polarity protected

Complete Kit, DC-7 .... $25.95
Assembled and calibrated ... 35.95

CALENDAR ALARM CLOCK 6 Digit LED 12/24 Hour

Has every feature one could ever ask for. Kit includes everything except case, build it into wall, station or even car! **FEATURES:**

- 6 Digits, .5" High LED
- Calendar shows mo./day
- True 24 Hour Alarm
- 12/24 Hour Format
- Snooze button
- 7001 chip does all!!
- Battery back up with built in on chip time base

Complete Kit, less case, DC-9 .... **$34.95**

600 MHz PRESCALER

$59.95

Assembled and tested. Extend the range of your counter to 600 MHz. Works with all counters. Available in kit form for $44.95. Specify ÷10 or ÷100 with order.

30 WATT 2 Meter Power Amp

The famous RE class C power amp now available mail order! Four Watts in for 30 Watts out, 2 in for 15 out, 1 in for 8 out, Incredible value, complete with all parts, instructions and details on T-R relay. Fully stable, output short proof, infinite VSWR protected! Case not included.

Complete Kit **$22.95**

COMING SOON: VIDEO TERMINAL KIT

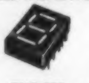
SEND FOR DETAILS
$149.95

TTL		LINEAR		REGULATOR		TRANSISTORS	
74S00	.35	555	.50	309K	.99	NPN 2N3904 type	10/$1.00
74S112	.75	556	.75	309H	.99	PNP 2N3906 type	10/$1.00
7447	.79	567	1.75	340K-12	1.25	NPN Power Tab 40W	3/$1.00
7473	.35	1458	.50	7805	.99	PNP Power Tab 40W	3/$1.00
7475	.50	LED DRIVER		7812	.99	FET MPF-102 type	3/$2.00
7490A	.55	75491	.50	7815	.99	UJT 2N2646 type	3/$2.00
74143	3.50	75492	.50	7818	.99	2N3055 NPN Power	.75

SPECIAL

DIODES: 1KV,2.5A .... 5/$1.00   100V,1A .... 10/$1.00   1N914A type .... 50/$2.00

LED DISPLAYS



FND 359	.4"	C.C.	.75
FND 510	.5"	C.A.	1.25
DL 707	.33"	C.A.	1.25
HP 7730	.27"	C.A.	1.25

Red Polaroid Filter ... 4.25" X 1.125" ... .59

741 OP-AMP SPECIAL

Factory prime mini dip with both Xerox and 741 part numbers
10 for $2.00

SOCKETS

14 PIN	5/$1.00
16 PIN	5/$1.00
24 PIN	2/$1.00
40 PIN	3/$2.00

FERRITE BEADS

with info and specs
15/$1.00
6 hole Balun Beads
5/$1.00

SOCKET KIT

Assortment of 12 most used IC sockets. Good to have around the shop. $1.95

8080A $18.95

Factory Prime – includes FREE socket!

21L02-1 $1.95 Fast 450 ns Low Power

60 Hz XTAL TIME BASE

- Runs on 5-15 VDC
- Low current (2.5 ma)
- Operate clocks in car, boat, plane
- 1 minute/month accuracy

Kit, TB-7 ... $5.50
Assembled & Calibrated ... $9.95

CHEAP CLOCK KIT

DC-4 Features:
- 6 digit .4" LED
- 12 or 24 format

$9.95
Does not include board or transformer

PC Board $2.95
Transformer $1.48

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MINI-KITS

FM Wireless Mike Kit

$2.95
FM-1

Transmit up to 300' to any FM broadcast radio. Sensitive mike input requires crystal ceramic or dynamic mike. Runs on 3 to 9 V. Super sensitive model FM-2 .. $4.95

TONE DECODER KIT

A complete tone decoder on a single PC Board. Features: 400-5000 Hz adjustable frequency range, voltage regulation, 567 IC. Useful for touch-tone decoding, tone burst detection, FSK demod, signaling, and many other uses. Use 7 for 12 button touchtone decoding. Runs on 5 to 12 volts.

Complete Kit, TD-1 .... **$4.95**

LED BLINKY KIT

A great attention getter which alternately flashes 2 Jumbo LEDs. Use for name badges, buttons, or warning type panel lights. Runs on 3 to 9 volts.

Complete Kit **$2.95**

SUPER-SNOOP AMPLIFIER

A super-sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as a general purpose test amplifier. Full 2 watts of output, runs on 6 to 12 volts, uses any type of mike. Requires 8-45 ohm speaker.

Complete Kit, BN-9 .... **$4.95**

MUSIC LIGHTS KIT

See music come alive! 3 different lights flicker with music or voice. One light for lows, one for the mid-range and one for the highs. Each channel individually adjustable, and drives up to 300 watts. Great for parties, band music, nite clubs and more.

Complete Kit, ML-1 .... **$7.95**

SIREN KIT

Produces upward and downward wail characteristic of police siren. 5 Watts audio output, runs on 3-9 volts, uses 8-45 ohm speaker.

Complete Kit, SM-3 .... **$2.95**

CODE OSCILLATOR KIT

Powerful 1 watt audio oscillator of approx. 1 kHz, good for many uses. Great for warning alarm, battery checker, voltage indicator and code oscillator.

Complete Kit, CPO-1 .... **$2.50**

POWER SUPPLY KIT

Complete triple regulated power supply provides variable ±15 volts at 200 mA and +5 volts at 1 Amp. 50 mV load regulation good filtering and small size. Kit less transformers. Requires 6-8 V at 1 Amp and 18 to 30 VCT.

Complete Kit, PS-3LT **$6.95**

DECADE COUNTER PARTS KIT

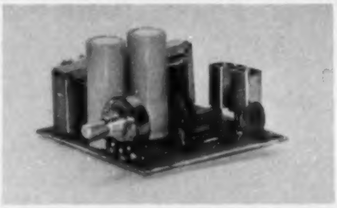
INCLUDES
- 7490A decade counter
- 7475 latch
- 7447 LED driver
- LED readout
- Current limit resistors

$3.50

Complete with instruction and details on how to build an easy, low cost freq. counter.

R8

SEE YOU IN ATLANTA – HAMFESTIVAL JUNE 18 & 19



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KIT $11.95

ASSEMBLED $17.95
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VARIABLE POWER SUPPLY

- Continuously Variable from 2V to over 15V
- Short-Circuit Proof
- Typical Regulation of 0.1%
- Electronic Current Limiting at 300mA
- Very Low Output Ripple
- Fiberglass PC Board Mounts All Components
- Assemble in about One Hour
- Makes a Great Bench or Lab Power Supply
- Includes All Components except Case and Meters

OTHER ADVA KITS:

LOGIC PROBE KIT—Use with CMOS, TTL, DTL, RTL, HTL, HiNIL and most MOS IC's. Built-in protection against polarity reversal and overvoltage. Draws only a few mA from circuit under test. Dual LED readout. Complete kit includes case and clip leads. **ONLY $7.85**

FIXED REGULATED POWER SUPPLY KITS—Short-circuit proof with thermal current limiting. Compact size and typical regulation of 0.5% make these ideal for most electronic projects. Available for 5V @ 500mA, 6V @ 500mA, 9V @ 500mA, 12V @ 400mA, 15V @ 300mA. Specify voltage when ordering. **$8.95 ea.**

These easy-to-assemble kits include all components, complete detailed instructions and plated fiberglass PC boards. Power supply kits do not include case or meters. Add $1.25 per kit for postage and handling.

†MAIL NOW! FREE DATA SHEETS supplied with many items from this ad. FREE ON REQUEST—741 Op Amp with every order of $5 or more—749 Dual Op Amp or two E100 FET's with every order of $10 or more, postmarked prior to 3/31/77. One free item per order.
ORDER TODAY—All items subject to prior sale and prices subject to change without notice. All items are new surplus parts—100% functionally tested.
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RC4195DN ±15V @ 50mA VOLTAGE REGULATOR IC. Very easy to use. Makes a neat Highly Regulated ±15V Supply for OP AMP's, etc. Requires only unregulated DC (18–30V) and 2 bypass capacitors. With Data Sheet and Schematics. 8-pin mDIP	$1.25
LM741 FREQ COMPENSATED OP AMP. µA741, MC1741, etc. mDIP	5/$1
MC1458 DUAL 741 OP AMP mDIP	3/$1
RC4558 DUAL 741 OP AMP mDIP	3/$1
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ZENERS—Specify Voltage 3.3, 3.9, 4.3, 5.1, 6.8, 8.2 400mW	4/$1.00
9.1, 10, 12, 15, 16, 18, 20, 22, 24, 27, or 33V (±10%) 1 Watt	3/$1.00

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- ALL TESTED AND GUARANTEED

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$5 & $10 ORDERS.†
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WITH MANY ITEMS.

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1N914*	15/$1
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1N3064	6/$1
1N3600	6/$1
1N4001*	12/$1
1N4002	12/$1
1N4003	12/$1
1N4004	12/$1
1N4005	10/$1
1N4006	10/$1
1N4007	10/$1
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1N4370 to 1N4372	2/$1
1N4454	15/$1
1N4728 to 1N4763	2/$1
1N5231 to 1N5236	4/$1
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F7 432MHz	$1
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MV1620 to MV1636	$1
MV1866 to MV1872	$2
MV2201 to MV2205	$1

TRANSISTORS	
2N706	$0.24
2N718	.24
2N720	.48
2N918	3/$1
2N1613	$0.29
2N1711	.29
2N1890	.30
2N1893	.38
2N2219	.26
2N2222	6/$1
2N2222A*	5/$1
2N2369	5/$1
2N2608 to 2N2609	$2
2N2905	$0.24
2N2906A	.24
2N2907*	5/$1
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2N3563	6/$1
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2N3565 to 2N3568	6/$1
2N3638	6/$1
2N3638A	5/$1
2N3641	5/$1
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2N3644	4/$1
2N3646	4/$1
2N3686 to 2N3688	3/$1
2N3691 to 2N3694	4/$1
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2N3823	.48
2N3860	.75
2N3903 to* 2N3906	6/$1
2N3910	$5.00
2N3932	1.00
2N3954	3.20
2N3958	1.15
2N3970	1.00

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2N4091	3/$1
2N4092	$0.75
2N4121	3/$1
2N4122	3/$1
2N4124	5/$1
2N4248	5/$1
2N4249	5/$1
2N4250	4/$1
2N4274	5/$1
2N4302	$0.29
2N4303	.29
2N4338	$1
2N4360M	2/$1
2N4391	$1
2N4392	$0.80
2N4416	2/$1
2N4416A	$0.80
2N4856 to 2N4861	$1
2N4867E	2/$1
2N4868E	2/$1
2N4881	$2.50
2N4888	$1
2N4965	3/$1
2N5087	4/$1
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2N5126 to 2N5135	5/$1
2N5138	5/$1
2N5139	5/$1
2N5163	3/$1
2N5197	$5.00
2N5199	2.50
2N5210	3/$1
2N5308	2/$1
2N5397	$1.50
2N5432	1.00
2N5457	3/$1
2N5458	$0.30
2N5484	3/$1
2N5486	3/$1
2N5543	$3.00
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2N5638	2/$1
2N5640	2/$1
CP643	$4.00
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E100	4/$1
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E102	3/$1
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SN7400N	.16
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SN7475N	.48
SN7476N	.35
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LM100H	$7.50
LM301AN	.27
LM307N	.27
LM308N	.90
LM309K	1.25
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LM320K-5	1.25
LM320K-12	1.35
LM320K-15	1.35

LINEAR IC's	
LM340K-5	$1.75
LM340T-5	1.75
LM340T-6	1.75
LM340T-12	1.75
LM340T-15	1.75
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LM380N	1.29
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LM723N*	3/$1
LM739N	$1.00
LM741CH	3/$1
LM741CN*	4/$1
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LM1304N	1.15
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LM2111N	$1.40
XR2556CP	1.66
2740EE	1.95
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CA3046	.84
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LM3900N	.55
RC4194D	1.50
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RC4195DN*	1.25
RC4195TK*	2.25
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µA7805UC	1.25
8038 DIP*	3.75
DM7540?	.85

*SUPER SPECIALS:

1N914 100V/10mA Diode	20/$1	MPF102 200MHz RF Amp	3/$1
1N4001 100V/1A Rect.	15/$1	40673 MOSFET RF Amp	$1.75
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BR1 50V ½A Bridge Rec	4/$1	LM376 Pos Volt Reg mDIP	.55
2N2222A NPN Transistor	6/$1	NE555 Timer mDIP	2/$1
2N2907 PNP Transistor	6/$1	LM723 2-37V Reg DIP	3/$1
2N3055 Power Xistor 10A	.89	LM741 Comp Op Amp mDIP	4/$1
2N3904 NPN Amp/Sw β100	6/$1	LM1458 Dual 741 mDIP	3/$1
2N3906 PNP Amp/Sw β100	6/$1	CA3086 5 Trans Array DIP	.85
CP650 Power FET ½Amp	$5	RC4195DN ±15V/50mA mDIP	1.25

RF391 RF Power Amp Transistor 10-25W @ 3-30MHz TO-3	$5.00
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RC4194TK Dual Tracking Regulator ±0.2 to 30V @ 200mA TO-66	$2.50
RC4195TK Dual Tracking Regulator ±15V @ 100mA (TO-66)	$2.25
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SPECIALS—THIS MONTH ONLY

1N34	Germanium Diode 60V 10mA	10/$1
1N6263	Hot Carrier Diode (HP2800, etc.)	$1.00
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2N3866	UHF Transistor—1 Watt at 432 MHz	$0.75
RCA29	NPN Power Amp/Switch 30W TO-220	.70
LM741	Compensated Op Amp mDIP or DIP	6/$1
LM1304	FM Multiplex Stereo Demodulator	$0.99
LM2111	FM IF Amp/Limiter/Detector	.99
CA3028A	RF/IFAmplifier DC to 120 MHz	1.45
RC4136	Quad 741 Op Amp—Low-Noise	.95
LP-10	LOGIC PROBE Kit—TTL, CMOS, etc. (See Above—"OTHER ADVA KITS")	$7.85

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BULLET ELECTRONICS

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WE BET THAT WE CAN SHIP ANYTHING IN THIS AD WITHIN 48 HOURS OF RECEIPT OF YOUR ORDER. If we lose we will still send your order and we will also send you a brand new silver* dollar for every $5.00 in merchandise you ordered!

IF WE WIN WE GET TO KEEP YOU AS A SATISFIED CUSTOMER... WANTA' BET??

*Silver dollars are new copper clad style. Refunds are calculated on nearest $5.00 increment. Sundays and holidays are excluded.

Mini Grandfather Clock Kit

- Completely Electronic
- 100% Solid State
- All CMOS IC Construction
- 2 Quality Plated PC Boards 6.5" x 4.5"
- New, revised easy to follow instructions
- Large ½" LED readout with AM/PM & colon indicators
- Simulated LED swinging pendulum with syncronized tick-tock sound.
- Chimes the hour (ie: 3 times for 3 o'clock)
- Adjustable volume tone and sustain on the chime.
- LOW COST
- Complete with all parts including transformer & speaker.

$39.95 kit **$59.95** (assembled & checked out)

SOLID WOOD CLOCK CASE

Handcrafted specifically for the Grandfather Clock (see picture above)

MADE FROM SELECT SOLID HARDWOOD. These beautiful cases are custom cut for the Mini Grandfather clock and available in either ASH or WALNUT. Case comes with pre-cut ruby front lens and back panel. The PC boards slide easily into two internal grooves to make installation quick and easy. Choose from the following:

Complete case assembled and finished – **$19.95**

Complete case kit. All pieces pre cut and notched, but unstained and unfinished – **$15.95**

PLEASE SPECIFY TYPE OF WOOD DESIRED, ASH OR WALNUT

ULTRASONIC SENDER-RECEIVER KIT

A special buy on a high quality ultrasonic transducer allows us to offer this kit at a super price – but hurry, quantities are limited! You can build intrusion alarms, motion detectors, remote controls, echo ranging or liquid level measurement equipment. We supply the basic transmitter and receiver electronics including a drilled and plated PC board. The units work at 23KHZ with a range of 20 ft. and can be positioned opposite each other or side-by-side and bounced off a solid surface. The output will sink up to 300ma to drive a relay, alarm circuit, etc.

ORDER US-01 **$19.95**

AUTOMATIC TIME-OUT CIRCUIT

Gives a 17 second entry delay, then triggers an alarm, light, etc. with 5–10 minute (selectable) time. Device rearms itself after the cycle. Directly compatable with the US–01 and Warble Alarm. Triggers on a "low" going transistion. Requires 12 VDC Will source or sink up to 200MA. **$3.95**

WARBLE ALARM KIT

Everybody is talking about it! A dual tone ear shattering sound that is impossible to ignore. Resembles the European siren sound. EASY to assemble!

$2.50

All necessary components & PC board, Less speaker.

5 to 10 watts output depending on speaker impedence. Useable from 3 to 15V (lower voltages gives reduced output). Requires 1 amp for full output.

OUR CUSTOMERS WRITE ABOUT OUR CDI KIT:

"...great kit."
"...unbelievable value", "...good design!"
"...fantastic kit and service. Send three more."

The CDI kit is all these things and more. Get in on a one-time deal. Complete electronics.
Requires heatsink (not included) also works for voltage source for high intensity strobe.

$9.95 BB

TAKE automatic 10% Discount on *MDSE.* orders of $50.00 or over.

SMILING JACK SPECIAL! CLOCK/TIMER KIT (MK-03)

May we recommend the Aircraft Clock/Timer? Features 24 hour Zulu time and up to 24 hours of elapsed time on the same set of six digit LED readouts. Totally independent operation of both functions. Clock has presettable alarm with 10 minute snooze. Timer has reset, hold, and count functions. Full noise and overvoltage protection. 24 hour only. Readouts has dimmer feature or they can be turned off without disturbing the clock or timer. Timebase included (.01% accuracy). Because of the many options and mounting considerations the case and switches are not included. Switches are standard types. Will fit inside standard aircraft instrument case or the medium shadow case (see BF-01).

9–14VDC 150MA W/readouts on
40MA W/readouts off **$26.95**

PS–12 HIGH CURRENT VARIABLE POWER SUPPLY KIT

A LOW COST WAY TO HAVE A QUALITY VARIABLE BENCH SUPPLY.

ALL ELECTRONICS SUPPLIED
LARGE COMPUTER GRADE FILTER
PLATED PC BOARD
UNIQUE PRE-REGULATOR ALLOWS COOLER OPERATION AT HIGH CURRENTS.
3 to 16V & 15 to 30V (two ranges) @ 10A CONTINUOUS (15A with fan cooling)
ADJUSTABLE CURRENT LIMITING
SHORT CIRCUIT PROTECTION

$49.95

Regulation: 240mv Load & Line
Ripple: Less than .5V @ 30V & 10A.

Add $3.70 for UPS shipping. Outside continental U.S. Add $10.00 for Parcel Post & Insurance.

OVER-VOLTAGE PROTECTION KIT (OVP–1)

$6.95

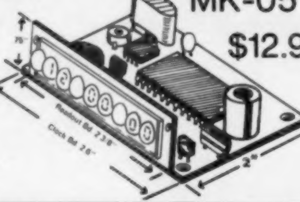
The OVP-1 will protect your expensive gear from voltage surges, power supply malfunction or tampering hands on your voltage adjust. Every regulated power supply should have one. Cheap insurance for expensive equipment. Adjustable from 3 to 30 volts DC. Useable on Supplies up to 25 amps. Power supply must be fused. Directly compatable with the PS-12 Power Supply. PC board and all parts suppled, including 25A SCR.

6 DIGIT MINI MOBILE ALARM CLOCK KIT

Many of our customers who have bought our other mobile clock kits (MK-03 & MK-04), have requested a small mobile clock for in dash mounting. We put our engineer to work on it and the result is the compact MK-05. Designed to be a mobile clock from the ground up. There has been no compromise on quality. **Take a look at the specs, price, size and compare it with any other clock kit on the market.** We will be waiting for your order!

- Quartz crystal timebase
- Toroid and zener noise & voltage protection
- Magnified .15 inch, 6 digit LED readout with spacing between hours, minutes, & seconds
- Top Quality epoxy glass PC boards are drilled & plated
- No additional components are required
- Complete with presettable 24 hr. alarm (speaker NOT included)
- Can be used as elapsed timer
- Easy, quick assembly
- 9–14 VDC @ 40 to 50 ma
- Readouts can be turned off & the clock continues to keep time
- PC board Clock: 2.6"x2"
  Readout board: 2 3/8"x.75"

MK-05 **$12.95**



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PRIME - HIGH SPEED RAM

21L02-3 400 NS

LOW POWER - FACTORY FRESH

1-24	$1.95 ea	100-199	$1.60 ea
25-99	1.75 ea	200-499	1.45 ea

OVER 500 PCS. **1.39** ea.

PRINTED CIRCUIT BOARDS for CT-7001 Kits sold separately with assembly info. PC Boards are drilled Fiberglass, solder plated and screened with component layout.
Specify for 7001 *B, C or X* - $7.95

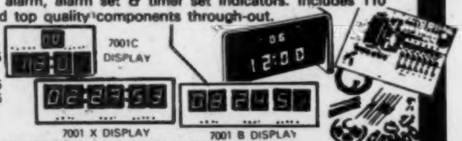
6-DIGIT LED CLOCK CALENDAR KIT

DATE-TIME-SNOOZE ALARM & MORE... KIT 7001

FOR THE BUILDER THAT WANTS THE BEST. FEATURING 12 OR 24 HOUR TIME — 29-30-31 DAY CALENDAR. ALARM, SNOOZE AND AUX. TIMER CIRCUITS

Will alternate time (8 seconds) and date (2 seconds) or may be wired for time or date display only, with other functions on demand. Has built-in oscillator for battery back-up. A loud 24 hour alarm with a repeatable 10 minute snooze alarm, alarm set & timer set indicators. Includes 110 VAC/60Hz power pack with cord and top quality components through-out.

KIT - 7001B WITH 6 - .5" DIGITS $39.95
KIT - 7001C WITH 4 - .6" DIGITS & 2 - .3" DIGITS FOR SECONDS $42.95
KIT - 7001X WITH 6 - .6" DIGITS $45.95



KITS ARE COMPLETE (LESS CABINET)
ALL 7001 KITS FIT CABINET I AND ACCEPT QUARTZ CRYSTAL TIME BASE KIT # TB-1

6 DIGIT LED CLOCK KIT #850-4

12/24 HR. OPERATION BIG .4" DIGITS - 50/60 HZ OPERATION.

KIT INCLUDES
- INSTRUCTIONS
- QUALITY COMPONENTS
- 50 or 60 Hz OPERATION
- 12 or 24 HR OPERATION

6-LED Readouts(FND-359 Red, com. cathode)
1-MM5314 Clock Chip (24 pin)
13-Transistors
3-Switches
6-Capacitors
5-Diodes
9-Resistors
24-Molex pins

Kit #850-4 will fit Plexiglas Cabinet II

$11.95 ea.	QTY. 1-5
$10.95 ea.	QTY. 6-11
$9.95 ea	QTY. 12 OR MORE

"Kit #850-4 will furnish a complete set of clock components as listed. The only additional items required are a 7-12 VAC transformer, a circuit board and a cabinet, if desired."

PRINTED CIRCUIT BOARD FOR KIT #850-4, SCREEN PRINTED DRILLED AND SOLDER PLATED FIBERGLASS $2.95
MINI-BRITE RED LED'S (FOR COLON IN CLOCK DISPLAY) ... Pkg. of 5-$1.00
MOLDED PLUG TRANSFORMER 115/10 VAC (WITH CORD) $2.50
NOTE: Entire Clock may be assembled on one PC Board or Board may be cut to remote display

MOBILE LED CLOCK

12/24 HR **.4" DIGITS!**

MODEL #2001 12 VOLT AC or DC POWERED

- 6 JUMBO .4" RED LED'S BEHIND RED FILTER LENS WITH CHROME RIM
- SET TIME FROM FRONT VIA HIDDEN SWITCHES • 12/24-Hr. TIME FORMAT
- STYLISH CHARCOAL GRAY CASE OF MOLDED HIGH TEMP. PLASTIC
- BRIDGE POWER INPUT CIRCUITRY — TWO WIRE NO POLARITY HOOK-UP
- OPTIONAL CONNECTION TO BLANK DISPLAY (Use When Key Off in Car, Etc.)
- TOP QUALITY PC BOARDS & COMPONENTS - EXCELLENT INSTRUCTIONS
- MOUNTING BRACKET INCLUDED

KIT #2001 COMPLETE KIT (Less 9V. Battery) 29.95 EA. 3 OR MORE $27.95 EA. 115 VAC Power Pack #AC-1 $2.50 EA.

ASSEMBLED UNITS ORDER #2001 WT WIRED & TESTED (LESS 9V. BATTERY) $39.95 EA. 3 OR MORE $37.95 EA.
WIRED FOR 12 HR. OP. IF NOT SPECIFIED OTHERWISE

60 HZ.

XTAL TIME BASE
Will enable Digital Clock Kits or Clock-Calendar Kits to operate from 12V DC.
1"x2" PC Board
Power Req: 5-15V (2.5 MA. TYP.)
Easy 3 wire hookup
Accuracy: ± 2PPM
#TB-1 (Adjustable)
Complete Kit $4.95 ea
Wir & Cal $9.95

PLEXIGLAS CABINETS

Great for Clocks or any LED Digital project. Clear-Red Chassis serves as Bezel to increase contrast of digital displays.

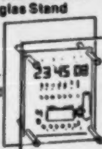
CABINET I 3"H,6¼"W,5½"D
CABINET II 2½"H,5"W,4"D

Black, White or Clear Cover
$6.50 ea.

RED OR GREY PLEXIGLAS FOR DIGITAL BEZELS
.3"x6"x1/8" 95¢ ea. 4/$3

SEE THE WORKS Clock Kit Clear Plexiglas Stand

- 6 Big .4" digits
- 12 or 24 hr. time
- 3 set switches
- Plug transformer
- all parts included



Plexiglas is Pre-cut & drilled
Kit #850-4 CP
Size: 6"H,4½"W,3"D
$23.50 ea. 2/$45.
A SUPER CLOCK!

JUMBO DIGIT CLOCK

A complete Kit (less Cabinet) featuring: six .5" digits, MM5314 IC, 12/24 Hr. time, 50/60 HZ., Plug-Transformer, Line Cord, Switches, and all Parts. (Ideal Fit in Cabinet II)
Kit # 5314-5 ... $19.95 2/$38.
WITH PC Boards

JUMBO DIGIT CONVERSION KIT $9.95 ea.
Convert small digit LED clock to large .5" displays. Kit includes 6 - LED's, Multiplex PC Board & easy hook-up info.
Kit # JD-1CC For common Cathode
Kit # JD-1CA for common Anode

TELEPHONE FORMAT KEYBOARD
BY Chomerics
EF-21360
2-1/4"x3"

5/32" thick
$4.95
6/$28.

25 AMP BRIDGE
$1.95 ea.
3/$5.00

NEW LSI TECHNOLOGY

FREQUENCY COUNTER KIT

8 LARGE .4" RED LED DIGITS

Kit #FC-50 • 8 IC's • XTAL TIME BASE

A truly "State of the Art" counter using quality components throughout.

KIT INCLUDES: DETAILED INSTRUCTIONS, XTAL, TOP QUALITY FIBERGLASS DOUBLE SIDED PC BOARD, IC'S WITH SOCKETS AND ALL PARTS LESS POWER SUPPLY AND CABINET.

50 MHZ COUNTER KIT	#FC-50	$69.95
5 VOLT REGULATED 1 AMP POWER SUPPLY KIT	#PS-02	$9.95
350 MHZ PRESCALER KIT	#PSL-350	23.95
650 MHZ PRESCALER KIT	#PSL-650	$29.95
CABINET [& MTG HARDWARE]	#CAB III	$19.95

[CABINET WILL HOUSE #FC-50, #PS-02, AND A PRESCALER]

Fairchild Super Digit FND-359

.4" Char. Ht. 7 segment LED RED Com. Cath. Direct pin replacement for popular FND-70.
95¢ ea, 10/$8.50
100/$79.00

SET OF 6 FND-359 WITH MULTIPLEX PC BOARD $6.95

NYLON WIRE TIES
8" TIE-WRAP 100/$1.95
4" TIE-WRAP 100/$1.75

PLUG TRANSFORMERS
12VAC at 150MA $2.50
12VAC at 500MA 3.50
7VAC at 1.75 VA $3.50

SCHOTTKY TTL

74S00	$ .35
74S01	.40
74S04	.55
74S05	.60
74S09	.55
74S10	.40
74S20	.50
74S22	.45
74S40	.45
74S50	.45
74S51	.55
74S60	.85
74S64	.55
74S74	.85
74S75	1.75
74S78	1.50
74S86	.95
74S107	.95
74S112	.95
74S113	1.40
74S114	.95
74S133	.75
74S134	.75
74S138	1.75
74S139	1.50
74S151	1.95
74S153	1.95
74S155	1.95
74S156	1.95
74S157	1.80
74S158	2.50
74S174	2.50
74S175	2.50
74S181	2.95
74S182	1.95
74S251	2.75

DIGITAL CLOCK IC's

MM5312	$ 4.95
MM5314	3.95
MM5375 AB	3.95
CT-7001	7.95
CT-7002	13.95
MM5369	2.50

LED DRIVERS

7447	$ .95
7448	.95
75491	.65
75492	.65
9368	2.80

PRESCALE

11C90DC	$15.95
95H90	9.95

VOLTAGE REGULATORS

LM 309 H	TO-5	$ .95
LM 309 K	TO-3	1.25
7805	TAB	.95
7812	TAB	1.25
7812	TO-3	1.50
7815	TO-3	1.25
7815	TAB	1.25
78L 15	TO-5	.75
7824	TO-3	1.25
723	DIP	.75
723	TO-5	.75

PROM

1702	E Prom	$8.95
5203	E Prom	$8.95

SPECIAL IC'S

7207A	INTERSIL	
7208	INTERSIL	
MC14553	MOT	$ 9.95
MC14410	MOT	$12.50
2513	SIG	$ 9.95

IC SOCKETS

PINS	1-24	25	100
8	$ .25	$ .22	$ .20
14	.25	.22	.20
16	.28	.25	.23
18	.31	.28	.26
24	.50	.45	.40
28	.60	.55	.50
40	.75	.70	.65

XTAL

5.242880 MHZ.	$4.95
3.579545 MHZ.	$1.95

MOLEX PINS

$9.95 Reel of 1000
100 for $1.25

TRANSISTORS

2N2222 A	TO-18	3/$1.00
2N2712	TO-98	5/$1.00
2N3415	TO-9	5/$1.00
2N3704	TO-92	5/$1.00
2N4400	TO-92	5/$1.00
2N4125	TO-92	5/$1.00
2N4249	TO-92	5/$1.00
2N4437	TO-92	5/$1.00
2N6027	PUT	2/$1.00
2N5457	N J-Fet	2/$1.00

DIODES

IN 4002	1A, 100 PIV	12/$1.00
IN 4005	1A, 600 PIV	11/$1.00
IN 4007	1A, 1000 PIV	10/$1.00
RECTIFIER	2.5A, 1000 PIV	4/$1.00
IN 914	SIL. SIGNAL	20/$1.00
IN 4148	SIL. SIGNAL	20/$1.00
DYAC	28V.	4/$1.00

LINEAR

555	TIMER	2/$1.00
556	DUAL TIMER	.95
565	PLL	.95
566	FUNCTION GEN.	1.75
567	TONE DECODER	1.75

TRANSISTOR SOCKET TO-5/18 GOLD PINS
5/$1.00

7-SEG LED

COMMON CATHODE

	COLOR	HT	DEC PT	PR EA
FND 359	RED	.4"	RHDP	$ .95
FND 503	RED	.5"	RHDP	$1.35
DL 750	RED	.6"	LHDP	$2.95
XAN 654	GREEN	.6"	NDP	$1.95
XAN 664	RED	.6"	NDP	$1.95

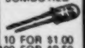
COMMON ANODE

DL 747	RED	.6"	LHDP	$1.95
XAN-72	RED	.3"	LHDP	$1.25
MAN 72	RED	.3"	LHDP	$1.25
XAN 81	YELLOW	.3"	RHDP	$1.75
XAN 351	GREEN	.3"	RHDP	$1.50
XAN 362	ORANGE	.3"	LHDP	$1.50
XAN 662	RED	.6"	NDP	$1.95
XAN 682	RED	.6"	NDP	$1.95

OP AMPS
3/$1.00

301	TO-5
709	DIP
709	TO 5
741	DIP
741	M-DIP
741	TO-5
747	TO 5

DISCRETE LED's
JUMBO RED



10 FOR $1.00
100 FOR $9.50

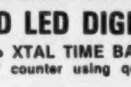
PC TRIM POTS
25K 6/$1.00
4.7K 6/$1.00

SPECTROL 10K 10 TURN 95c 4/$3.00

CMOS

	ea.
4001	$ .20
4002	.20
4010	.40
4011	.20
4013	.40
4015	.95
4016	.40
4023	.20
4025	.20
4027	.40
4028	.85
4030	.35
4042	.75
4044	.60
4046	1.75
4049	.40
4050	.40

AUTO BURGLAR ALARM KIT



AN EASY TO ASSEMBLE AND EASY TO INSTALL ALARM PROVIDING MANY FEATURES NOT NORMALLY FOUND. KEYLESS ALARM HAS PROVISION FOR POS. & GROUNDING SWITCHES OR SENSORS. WILL PULSE HORN RELAY AT 1HZ RATE OR DRIVE SIREN. KIT PROVIDES PROGRAMMABLE TIME DELAYS FOR EXIT, ENTRY & ALARM PERIOD. UNIT MOUNTS UNDER DASH - REMOTE SWITCH CAN BE MOUNTED WHERE DESIRED. CMOS RELIABILITY RESISTS FALSE ALARMS & PROVIDES FOR ULTRA DEPENDABLE ALARM. DO NOT BE FOOLED BY LOW PRICES! THIS IS A TOP QUALITY COMPLETE KIT WITH ALL PARTS INCLUDING DETAILED DRAWINGS AND INSTRUCTIONS OR AVAILABLE WIRED AND TESTED.

KIT #ALR-1 $9.95
#ALR-1WT WIRED & TESTED $19.95

VARIABLE REGULATED 1 AMP POWER SUPPLY KIT

- VARIABLE FROM 4 to 14V
- SHORT CIRCUIT PROOF
- 723 IC REGULATOR
- 2N3055 PASS TRANSISTOR
- CURRENT LIMITING AT 1 Amp

KIT IS COMPLETE INCLUDING DRILLED & SOLDER PLATED FIBERGLASS PC BOARD AND ALL PARTS (Less TRANSFORMER) KIT #PS-01 $8.95

TRANSFORMER 24V CT will provide 300MA at 12V and 1 Amp at 5V. $3.50

OPTOELECTRONICS, INC.

BOX 219 • HOLLYWOOD, FLA. 33022 • (305) 921-2056
STORE: 823 S. 21 AVE.

ORDER BY PHONE OR MAIL
COD ORDERS WELCOME
Orders Under $15 Add $1.00 Handling
Fla. Res. Please Add 4% Sales Tax.

WE PAY ALL SHIPPING IN CONTINENTAL USA — OTHERS ADD 5% [10% FOR AIRMAIL]
SEE OUR BOOTHS AT THE ATLANTA HAMFESTIVAL - JUNE 18-19, 1977

New!

Synthacoder

E.S.C.
6.2 8 0
INVALID
CODE
Synthacoder 22
HIGH
DUP A
LOW
DUP B
SQL
VOL
22
RF OUT
ICOM IC-22S
VHF FM TRANSCEIVER

☆ ALL NEW SYNTHESIZER/ENCODER FROM ENGINEERING SPECIALITIES
THE ULTIMATE IN FREQUENCY CONTROL FOR IC-22S OWNERS!

No more soldering diodes every time you want to try a new repeater!
Just plug the Synthacoder into the back of your radio, select channel 22, and the Synthacoder takes command of your radio – Giving you fingertip control of ALL frequencies.

- Front Panel Thumbwheel Control of All Channels!
- Fully Automatic Invalid Code Control!
- Small Size: 3¾" x 1½" x 6"
- Factory Wired and Tested
- Easy To Install

SPECIAL
only $87.95
postpaid
CA Residents add 6% sales tax

Engineering Specialties

P.O. BOX 2233
1247 COMMERCIAL AVENUE
OXNARD CA 93030
(805) 486-0817

☐ I'LL BITE! Please send more info.
☐ I'M HOOKED! Please RUSH my Synthacoder.

YES, I would like to purchase a Synthacoder for my IC-22S. Enclosed please find my $87.95 (Price includes postage and handling). California residents add 6% sales tax.

$________ enclosed. ☐ Cash ☐ Check ☐ Money Order
Please charge my ☐ Master Charge ☐ BankAmericard
Credit card #______________________________
Interbank #________________
Expiration date________________
Signature____________________________________

master charge

Name____________________________________ Call____________
Address____
City_____________________________ State______ Zip_______

BankAmericard

E12

HOBB-Y-TRONIX, INC.

BIG-BRIGHT - .5" LED ALARM CLOCK
6 DIGIT AC or DC or ELAPSED TIMER KIT
$19.95 Complete

- PC Board Drilled & Silk Screened (Includes Xtal Time Base Circuitry)
- 5375 Nat. Clock Chip & Fairchild Displays
- Includes EVERY part required for clock and all options except Cabinet and Crystal Time Base components. If desired, see below.
- Brightness Control
- 24 Hr. Alarm w/snooze
- Freeze feat. on every mode
- 0-60 Min. Elapsed Timer
- Field Tested over 1 Yr.
- 12 Hr., 60 Hz oper.

Most Important — Complete Instructions, schematics Pictorials, layouts — everything for trouble free assembly

OPTION — XTAL Time Base Components - $2.95 when purchased w/clock

WOOD CLOCK CABINETS

Includes: Filter & Back

Walnut Grain or
Black Leatherette Finish
$5.00 ea.

Dimensions (Inside)
A — 1-13/16"H, 5½"W, 4¾"D
B — 1⅞"H, 4¾"W, 4¾"D
Extra Filters — Red, Smoke Blue, Amber, & Green — $.60

AC/DC - ALARM Clock Kit - 12/24 Hr.
$7.50 quantities of 1-5 $6.50 quantities of 6 & up

- **Your choice of Display Colors - Red, Green, Blue, Amber**
- Displays Hrs. & Min. - Switch to Min. & Secs. on Command.
- AM/PM Indication
- Field Tested for 6 months

The kit will include a 5316 National Clock Chip, 4 Flourescent Display tubes, all electronic components, switches, controls & complete instructions, specs, etc. for clock and all optional Features. Other parts required or if desired are as follows:

- PC Board, Drilled & Silk Screened $3.00
- Xformer (for AC oper.) — $1.00 App. (SCR output) timer kit — $2.00
- Speaker Alarm Kit — $2.00 CountDown (turn-off) timer kit — $2.00

CLOCK CHIPS

MM5314	$3.50
MM5316	3.50
MM5387 (Hi Cur. 5316)	3.95
MM5375	3.95
CT7001	7.95
CT7010	6.95

CRYSTALS

3.579545 MHZ	$1.95

DIODES

IN4001-IN4007 Mix	50 for 4.00
IN914 or IN4148	20 for 1.00
2.5 Amp 1000 Volts	5 for 1.00

LED DRIVERS

SN7447	.95
ITT200	.50
ITT201	.50

TRANSFORMERS

Plug type-12VAC 250MA	2.50
PC Mnt.-12VAC 250MA	1.50
Bkt Mnt.-5VAC 6 Amp	4.95

IC SOCKETS

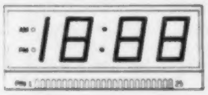
8 Pin	5 for 1.00
14 Pin	5 for 1.00
16 Pin	4 for 1.00
18 Pin	4 for 1.00
24 Pin	3 for 1.00
28 Pin	3 for 1.00
40 Pin	2 for 1.00

THE BIG ONE
.8" LED Alarm Clock Kit

Big Digits

Big Bargain Price

simple construction



$17.95 Complete

Includes:
Power Supply, Speaker, IC Socket
PC Board, Clock Chip, Switches
Fairchild .8" Display Module,
xistors, resistors, capitors,
Complete Instructions

Features:
- Hrs. & Min. Switch to Min. & Sec. on Command
- 12 Hr. - 24 Hr. Alarm
- 10 Min. Snooze
- AM/PM Indicators
- Sleep Output

7 SEG LED DISPLAYS

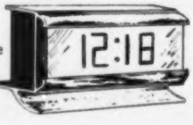
FND359 Common Cathode Red	$ .90
DL704/707 C.C./C.A. 33" Red	1.00
FND503/507 C.C./C.A. .50" Red	1.25
DL747/750 C.C./C.A. .60" Red	1.95
FND8000 C.C. .80" 4 Digit Mod. Red	4.50

SWITCHES

Pushbutton-Mon. On	3 for 1.00
Mini Toggle-SPDT	1.25
Mini Toggle-SPDT On-Center Off-Mon On	1.25
Mini Toggle-DPDT	1.50
Rocker SPDT	6 for 1.00
Rocker DPDT	5 for 1.00

The SUPER COMPACT
$13.95 Complete

Includes: All Parts, PC Board
Power Supply & Case
Colors: Black, Silver, or Gold
Size: 4.75" x 1.8" x 1.4"
Material: Extruded Alum.



OPTION — Temperature Ind. Front Panel — $3.00

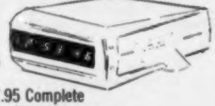
Features:
4-large .4" LED Displays
12/24 hour Format

60 HZ. CRYSTAL TIME BASE KIT
$4.95

Use with Digital Clocks
for 12VDC or Portable Operation
KIT INCLUDES:
PC Board, 5369 Divider Chip
3.5795 MHZ XTAL &
All Other Parts
Complete Instructions

6 DIGIT LED MOBILE
Clock Kit & Elapsed Timer

.4" Digits 12 or 24 Hr.
Quartz Crystal Controlled
12 Volt DC or AC operation



$27.95 Complete
(less 9V battery)

- Protection from noise & High Impulses
- Display Blanking Capability
- Battery Back-Up Capability
- Size 4" x 1¼" x 4½"
- Rugged High Impact ABS
- Recessed Front Switches

OPTION — AC Adaptor $2.50

MA1003 (National) Mobile Clock Module .. $24.95

Voltage Regulators

Positive-To 220 Pkg.		Negative-To 220 Pkg.	
7805	$1.00	7905	$1.25
7806	1.00	7912	1.25
7812	1.00	7915	1.25
7815	1.00	To-3 Pkg.	
7824	1.00	LM309K	1.25

SPECIALS

Jumbo Red LED's	10 for 1.00	100 for 9.00
25 Pk. LED's Asstd. Sizes & Colors		2.50
Bi-Polar LED Red/Green		1.00

Transistors		Bridges	
2N2222A	4/1.00	1½ Amp 200 volt	3/1.00
2N3904 type NPN	8/1.00	6 Amp 600 volt	3/2.00
2N3906 type PNP	8/1.00	25 Amp 200 volt	3/5.00
2N3055 (NPN,TO-3)	.75	Prescalers	
2N4904 (PNP,TO-3)	.85	95H90	8.95
		11C90	14.95

SPRAGUE IC'S

ULN-3306M Dual Schmitt Trigger	$.75 ea.	5 for $3.00
ULN-2285 Audio Amp. 3-5 watts	$1.25 ea.	6 for 5.00

6 Digit LED Stop-Watch Kit
Split Time $29.95 complete Taylor Time

FEATURES: Reads minutes, seconds, & 100ths of seconds
6 bright easily readable digits
Needs only 1 9 volt Xistor battery

KIT INCLUDES:
- Hand held case designed for above
- Latest Technology Intersil Mos Chip # 7205
- 3.2768 MHz Crystal
- Variable Trimmer Cap
- 2 mini slide & 3 MOM. PB Switches
- 3 pairs (6 digits) Double Digit LED Displays

P.C. BOARD for above

Blinky/Flasher/Timing Kit
$2.50 each 5 for $10.00

Kit includes:
P.C. Board, 555 Timer, all components and a connector for a 9V Battery

COMPUTER CORNER

2102 Sig. or Fair	$1.35 8 for 9.00
Memories: 2102-1 Sig. Hi Speed	1.50 ea. 8 for 10.00
21L02-1 Fair-Hi Speed-Low Pwr.	1.95 8 for 12.00
Prom: 82S23	3.00
Microprocessor - 8080A	14.95

Ribbon Cable 28 gauge

	1-10 ft	10-25 ft	25-100 ft
12 to 20 conductor	.25/ft	.20/ft	.15/ft
24 to 36 conductor	.30/ft	.25/ft	.20/ft
40 to 50 conductor	.35/ft	.30/ft	.25/ft

Specify color cable desired-Gray, Blue, & Pink

Box 511, Edison, N.J. 08817

Orders must incl. Ck. - No COD's - Add $1.00 handling for orders under $25.00 - Outside Cont. USA add 5% Postage - 10% Air Mail - N.J. resid. add 5% Tax

GODBOUT

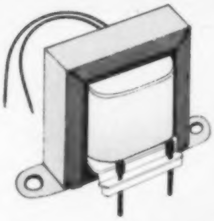
BILL GODBOUT ELECTRONICS
BOX 2355, OAKLAND AIRPORT, CA 94614

TERMS: Please allow up to 5% for shipping; excess refunded. Californians add sales tax. Street address must be included for COD orders. Place BankAmericard® and Mastercharge® orders ($15 minimum) by calling our 24 hour order desk at (415) 562-0636.

FREE FLYER: Just give us the word and we'll send out a copy of our flyer, which describes our complete line of products in greater detail.

SPECIAL #1

12 Volts, 350 mA



$1.50

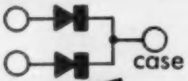
Good through 7/31

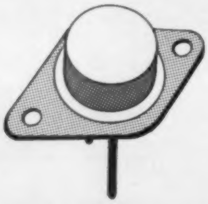
Regular price $1.95

SPECIAL #2

Good through 7/31

30A DC RECTIFIER





$1.95

INCLUDES finned heat sink and socket

MOTHERBOARD $89

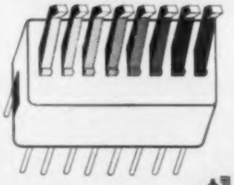
Use with the IMSAI microcomputer as an add-on with room for 10 peripherals, or for starting an 11 slot stand-alone system. Comes with 10 edge connectors---lots of places would charge you the cost of our Motherboard for these alone. Active, regulated terminations, included on board, minimize the crosstalk, noise, overshoot, and ringing you can find on improperly terminated busses. And of course, we use an epoxy glass board, with bypass caps and heavy power traces included. Get yourself one of these, a Morrow Sigma-100 Front Panel, some ECONORAM II boards and a power supply, and you're well on your way to a powerful system at a really good price.

...also 18 SLOTS $124

HI-FI CABLES

10/$4.40

RCA plug at one end; tinned wires at other end. FOURTEEN FEET min. length. Great value for audio!



EIGHT POLE SINGLE THROW

TOGGLE ACTION

$1.95

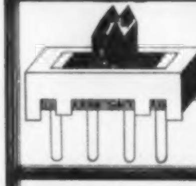
Small System Power Supply

Finally, a quality, cost-effective supply for small systems. Gives you a full 4 Amps at 5 Volts, with crowbar overvoltage protection, along with half an Amp of +12 and half an Amp of -12...and an additional 10 mA supply, adjustable over 5 to 10V for biasing required by some CPUs. Although intended to be used with computer systems, it's also a dandy little bench supply for digital experiments.

$45

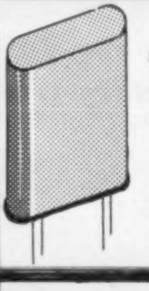
Power Transformer

$22.50 (+ postage for 6 lbs) brings you a hefty transformer. **117 VAC primary, 16V @ 12A RMS secondary.** Custom made to our specifications for high power applications. **Order part #G111.**



SUBMINI PC MOUNT SLIDE SWITCH
Center off SPDT. Only 5/8'' by ¼'' with pins on 1/8'' centers.
A VERY GOOD BUY..........10/$2

CRYSTALS



STATEK 3-lead xtals give .01% accuracy in a TO-5 can; use for fixed freq oscillators or with binary dividers to generate other freqs. Choose from (all freqs in KHz) 10.000 12.800
15.360 16.000 16.384 18.641 19.200 20.480 30.720 31.500
32.768 38.400 40.960 60.000 76.800 100.00 153.60 240.00

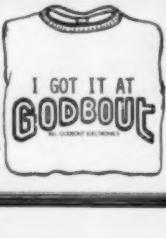
ALL STATEK CRYSTALS ARE $5 EACH.

The following crystals are series mode, fundamental, with wire leads...for hams and computer bugs. Choose from 4, 5, 8, 9, 10, 12, 15, 18, and 20 MHz (all $5 each). **Also available:** 500 KHz ($5), 1 MHz ($6), and 2 MHz ($5.50).

CAVE grafix

20 uF, 16 Volt axial cap 10/$1

$5.00



OUR FIRST T-SHIRT!

We knew it had to come to this some day, what with CAVE Grafix being T-shirt fanatics: so here it is, our very own T-shirt. It's 100% cotton, fully washable, and made by Haynes...so you know it's good. Specify small, medium, or large.

7400N TTL

SN7400N	.16	SN7459A	.25		
SN7401N	.16	SN7460N	.22	SN74154N	1.00
SN7402N	.21	SN7470N	.45	SN74155N	.99
SN7403N	.16	SN7472N	.30	SN74156N	.99
SN7404N	.18	SN7473N	.37	SN74157N	.99
SN7405N	.24	SN7474N	.32	SN74160N	1.25
SN7406N	.20	SN7475N	.50	SN74161N	.99
SN7407N	.20	SN7476N	.32	SN74163N	.99
SN7408N	.25	SN7479N	5.00	SN74164N	1.10
SN7409N	.25	SN7480N	.50	SN74165N	1.10
SN7410N	.18	SN7482N	.99	SN74166N	1.25
SN7411N	.30	SN7483N	.70	SN74167N	5.50
SN7412N	.33	SN7485N	.89	SN74170N	2.10
SN7413N	.45	SN7486N	.30	SN74172N	6.95
SN7414N	.70	SN7488N	3.50	SN74173N	1.50
SN7416N	.35	SN7489N	2.40	SN74174N	1.25
SN7417N	.35	SN7490N	.45	SN74175N	.99
SN7420N	.21	SN7491N	.75	SN74176N	.90
SN7421N	.33	SN7492N	.40	SN74177N	.90
SN7422N	.40	SN7493N	.49	SN74180N	.90
SN7423N	.37	SN7494N	.79	SN74181N	2.49
SN7425N	.29	SN7495N	.79	SN74182N	.95
SN7426N	.29	SN7496N	.89	SN74184N	1.95
SN7427N	.37	SN7497N	4.00	SN74185N	2.20
SN7429N	.42	SN74100N	1.00	SN74186N	15.00
SN7430N	.26	SN74107N	.30	SN74187N	6.00
SN7432N	.31	SN74121N	.30	SN74188N	3.95
SN7437N	.27	SN74122N	.39	SN74190N	1.10
SN7438N	.27	SN74123N	.59	SN74191N	1.25
SN7439N	.25	SN74125N	.60	SN74192N	.89
SN7440N	.15	SN74126N	.60	SN74193N	.89
SN7441N	.89	SN74132N	1.00	SN74194N	1.25
SN7442N	.59	SN74136N	.95	SN74195N	.75
SN7443N	.75	SN74141N	1.15	SN74196N	1.25
SN7444N	.75	SN74142N	4.00	SN74197N	.75
SN7445N	.75	SN74143N	4.50	SN74198N	1.75
SN7446N	.81	SN74144N	4.50	SN74199N	1.75
SN7447N	.69	SN74145N	1.15	SN74200N	5.90
SN7448N	.79	SN74147N	2.35	SN74279N	.90
SN7450N	.26	SN74148N	2.00	SN74251N	1.79
SN7451N	.27	SN74150N	1.00	SN74284N	6.00
SN7453N	.27	SN74151N	.79	SN74285N	6.00
SN7454N	.20	SN74153N	.89	SN74367N	.75

MANY OTHERS AVAILABLE ON REQUEST
20% Discount for 100 Combined 7400's

CMOS

CD4000	.25			74C04N	.75
CD4001	.25			74C10N	.65
CD4002	.25	CD4035	1.85	74C20N	.65
CD4006	2.50	CD4040	2.45	74C30N	.65
CD4007	.25	CD4042	1.99	74C42N	2.15
CD4009	.59	CD4044	1.89	74C73N	1.50
CD4010	.59	CD4046	2.51	74C74	1.15
CD4011	.25	CD4047	2.75	74C90N	3.00
CD4012	.25	CD4049	.79	74C93N	2.00
CD4013	.47	CD4050	.79	74C107N	1.25
CD4016	.59	CD4051	2.95	74C151	2.90
CD4017	1.35	CD4053	2.95	74C154	4.00
CD4019	.55	CD4060	3.25	74C157	2.15
CD4020	1.49	CD4066	1.75	74C160	3.25
CD4022	1.25	CD4069	.45	74C161	3.25
CD4023	.25	CD4071	.45	74C163	3.00
CD4024	1.50	CD4081	.45	74C164	3.25
CD4025	.25	CD4511	2.50	74C173	2.60
CD4027	.69	CD4518	2.50	74C193	2.75
CD4028	1.65	MC14566	3.00	74C195	2.75
CD4029	2.90	74C00N	.39	MC4044	4.50
CD4030	.65	74C02N	.55	MC14016	.56

LINEAR

LM300H	.80			LM1351N	1.65
LM301H	.35			LM1414N	1.75
LM301CN	.35	78MG	1.75	LM1458C	.65
LM302H	.75	LM370N	1.15	LM1496N	.95
LM304H	1.00	LM373N	3.25	LM1556V	1.85
LM305H	.95	LM377N	4.00	LM2111N	1.95
LM307CN	.35	LM380N	1.39	LM2901N	2.95
LM308H	1.00	LM380CN	1.05	LM3065N	.69
LM308CN	1.00	LM381N	1.79	LM3900N	.59
LM309H	1.10	LM382N	1.79	LM3905N	.60
LM309K	.99	NE501K	8.00	LM3909	1.25
LM310CN	1.15	NE510A	6.00	LM5556N	1.85
LM311H	.90	NE531H	3.00	MC5558V	1.00
LM311N	.90	NE536T	6.00	LM7525N	.90
LM318CN	1.50	NE540L	6.00	LM7535N	1.25
LM319N	1.30	NE550N	.79	8038B	4.95
LM320K-5	1.35	NE555V	.39	LM75450	.49
LM320K-5.2	1.35	NE560B	5.00	75451CN	.39
LM320K-12	1.35	NE561B	5.00	75452CN	.39
LM320K-15	1.35	NE562B	5.00	75453CN	.39
LM320T-5	1.75	NE565H	1.25	75454CN	.39
LM320T-5.2	1.75	NE565N	1.75	75491CN	.79
LM320T-8	1.75	NE566CN	1.25	75492CN	.89
LM320T-12	1.75	NE567H	1.95	75494CN	.89
LM320T-15	1.75	NE567V	1.50	**RCA LINEAR**	
LM320T-18	1.75	LM703CN	.45	CA3013	2.15
LM320T-24	1.75	LM709H	.29	CA3023	2.55
LM323K-5	9.95	LM709N	.29	CA3035	2.48
LM324N	1.80	LM710N	.79	CA3039	1.35
LM339N	1.70	LM711N	.39	CA3046	1.30
LM340K-5	1.95	LM723H	.55	CA3059	3.25
LM340K-6	1.95	LM723N	.55	CA3060	3.25
LM340K-8	1.95	LM733N	1.00	CA3080	.85
LM340K-12	1.95	LM739N	1.00	CA3081	2.00
LM340K-15	1.95	LM741CH	.35	CA3082	2.00
LM340K-18	1.95	LM741CN	.35	CA3083	1.60
LM340K-24	1.95	LM741-14N	.39	CA3086	.85
LM340T-5	1.75	LM747H	.79	CA3089	3.75
LM340T-6	1.75	LM747N	.79	CA3091	10.20
LM340T-8	1.75	LM748H	.39	CA3102	2.95
LM340T-12	1.75	LM748N	.39	CA3123	2.15
LM340T-15	1.75	LM1303N	.90	CA3130	1.39
LM340T-18	1.75	LM1304N	1.19	CA3140	1.25
LM340T-24	1.75	LM1305N	1.40	CA3600	1.75
LM350N	1.00	LM1307N	.85	RC4194	5.95
LM351CN	.65	LM1310N	2.95	RC4195	3.25

74LS00 TTL

74LS00	29			74LS139	1.95
74LS02	29			74LS151	1.55
74LS03	29	74LS74	49	74LS153	1.89
74LS04	35	74LS75	69	74LS157	1.55
74LS05	35	74LS76	49	74LS162	2.25
74LS08	29	74LS83	1.75	74LS163	2.25
74LS10	29	74LS85	2.49	74LS164	1.95
74LS13	69	74LS86	49	74LS175	1.95
74LS14	1.75	74LS90	1.95	74LS181	3.60
74LS20	29	74LS92	1.25	74LS190	2.85
74LS26	39	74LS93	1.25	74LS191	2.85
74LS27	39	74LS95	1.95	74LS192	2.85
74LS28	39	74LS96	1.89	74LS193	2.85
74LS30	29	74LS107	59	74LS194	1.89
74LS32	39	74LS109	59	74LS195	1.89
74LS40	39	74LS112	59	74LS257	1.75
74LS51	29	74LS132	1.25	74LS260	.55
74LS55	29	74LS136	59	74LS279	.79
74LS73	49	74LS138	1.89	74LS670	3.95

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MM5309	6 Digit, BCD Outputs, Reset Pin.	$9.95
MM5311	6 Digit, BCD Outputs, 12 or 24 Hour	4.95
MM5312	4 Digit, BCD Outputs, 1 PPS Output	4.95
MM5314	6 Digit, 12 or 24 Hour, 50 or 60 Hz	4.95
MM5316	4 Digit, Alarm, 1 PPS Output	6.95
MM5318	Video Clock Chip, For Use With (MM5841 - $9.95)	9.95
CT7001	6 Digit, Calendar, Alarm, 12 or 24 Hour	5.95

DATA HANDBOOKS

7400	Pin-out & Description of 5400/7400 ICS	$2.95
CMOS	Pin-out & Description of 4000 Series ICS	$2.95
Linear	Pin-out & Functional Description	$2.95

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— Watches —

T201 Black Bracelet $19.95
LED

T227 White w/bracelet $29.95
T226 Yellow w/bracelet $34.95
LED

Men's & Ladies
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- Displays hour, minute, second, month & day
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TC440 Yellow w/strap $34.95
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#8113 - Blackjack (1 or 2 players)
#8114 - Spitfire (1 or 2 players)
#8115 - Space War
#8111 - Tic-Tac-Toe/Shooting Gallery/Doodle/Quadra-Doodle

DISCRETE LEDS

.125" dia.			.190" dia.		
XC209	Red	10/$1	XC111	Red	10/$1
XC209	Green	4/$1	XC111	Green	4/$1
XC209	Orange	4/$1	XC111	Yellow	4/$1
XC209	Yellow	4/$1	XC111	Orange	4/$1

.200" dia.			.185" dia.			.200" dia.			.085" dia.
XC22	Red	10/$1	XC526	Red	5/$1	XC556	Red	10/$1	MV50 - Red - 6/$1
XC22	Green	4/$1	XC526	Green	4/$1	XC556	Green	4/$1	INFRA-RED LED ¼" x ¼" x 1/16" Flat 5/$1.00
XC22	Yellow	4/$1	XC526	Yellow	4/$1	XC556	Yellow	4/$1	
XC22	Orange	4/$1	XC526	Orange	4/$1	XC556	Orange	4/$1	
SSL-22	RT	4/$1	XC526	Clear	4/$1	XC556	Clear	7/$1	

SPECIAL * — XC556 Red 100/$8.00 1000/$60.00 — SPECIAL *

DISPLAY LEDS

DL707 DL338

TYPE	POLARITY	HT		TYPE	POLARITY	HT	
MAN 1	Common Anode	.270	2.95	MAN 3640	Common Cathode-orange	.300	1.75
MAN 2	5 x 7 Dot Matrix	.300	4.95	MAN 4710	Common Anode-Red	.400	1.95
MAN 3	Common Cathode	.125	3/1.00	DL701	Common Anode-red ±	.300	.99
MAN 4	Common Cathode	.187	1.95	DL704	Common Cathode	.300	.99
MAN 7	Common Anode	.300	1.25	DL707	Common Anode	.300	.99
MAN 7G	Common Anode-green	.300	1.95	MAN 4740	Common Anode-Red	.400	.99
MAN 7Y	Common Anode-yellow	.300	1.95	DL741	Common Anode	.600	1.99
MAN 52	Common Anode-green	.300	.99	DL 747	Common Anode	.600	2.25
MAN 64	Common Anode-red	.400	.99	DL 750	Common Cathode	.600	2.49
MAN 74	Common Cathode	.300	1.50	DL 338	Common Cathode	.110	.99
MAN 82	Common Anode-yellow	.300	.99	FND70	Common Cathode	.250	.75
MAN 84	Common Cathode-yellow	.300	.99	FND500	Common Cathode	.500	1.00
MAN 3620	Common Anode -orange	.300	1.75	FND507	Common Anode	.500	1.00

FACTORY REJECTS ATARI GAME BOARDS

BOARD A — 8½" x 16"
Over 60 each reusable IC's
Misc. Transistors, Resistors, Diodes, Caps, Crystals, Switch, etc.
$6.95 ea.
ONLY 500 EA AVAILABLE

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ONLY 500 EA AVAILABLE

HP 5082-7300 Multi-Digit Series

- ½" Ht. • Common Cathode • Dip Package
- 3 to 5 volts @ 5 mils per segment
- 7 segment Monolithic • Red Display

2 Digit	$ .79
3 Digit	.89
4 Digit	.99
5 Digit	1.19

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin	$.17	.16	.15	24 pin	$.38	.37	.36
14 pin	.20	.19	.18	28 pin	.45	.44	.43
16 pin	.22	.21	.20	36 pin	.60	.59	.58
18 pin	.29	.28	.27	40 pin	.63	.62	.61
22 pin	.37	.36	.35				

SOLDERTAIL STANDARD (TIN)

14 pin	$.27	.25	.24	28 pin	$ .99	.90	.81
16 pin	.30	.27	.25	36 pin	1.39	1.26	1.15
18 pin	.35	.32	.30	40 pin	1.59	1.45	1.30
24 pin	.49	.45	.42				

SOLDERTAIL STANDARD (GOLD)

8 pin	$.30	.27	.24	24 pin	$ .70	.63	.57
14 pin	.35	.32	.29	28 pin	1.10	1.00	.90
16 pin	.38	.35	.32	36 pin	1.75	1.40	1.26
18 pin	.52	.47	.43	40 pin	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

10 pin	$.45	.41	.37	24 pin	$1.05	.95	.85
14 pin	.39	.38	.37	28 pin	1.40	1.25	1.10
16 pin	.43	.42	.41	36 pin	1.59	1.45	1.30
18 pin	.75	.68	.62	40 pin	1.75	1.55	1.40

50 PCS. RESISTOR ASSORTMENTS $1.25 PER ASST.

SPECIAL

ASST. 1	5 ea.	10 OHM 27 OHM	12 OHM 33 OHM	15 OHM 39 OHM	18 OHM 47 OHM	22 OHM 56 OHM	1/4 WATT 5% — 50 PCS.
ASST. 2	5 ea.	68 OHM 180 OHM	82 OHM 220 OHM	100 OHM 270 OHM	120 OHM 330 OHM	150 OHM 390 OHM	1/4 WATT 5% — 50 PCS.
ASST. 3	5 ea.	470 OHM 1.2K	560 OHM 1.5K	680 OHM 1.8K	820 OHM 2.2K	1K 2.7K	1/4 WATT 5% — 50 PCS.
ASST. 4	5 ea.	3.3K 8.2K	3.9K 10K	4.7K 12K	5.6K 15K	6.8K 18K	1/4 WATT 5% — 50 PCS.
ASST. 5	5 ea.	22K 56K	27K 68K	33K 82K	39K 100K	47K 120K	1/4 WATT 5% — 50 PCS.
ASST. 6	5 ea.	150K 390K	180K 470K	220K 560K	270K 680K	330K 820K	1/4 WATT 5% — 50 PCS.
ASST. 7	5 ea.	1M 2.7M	1.2M 3.3M	1.5M 3.9M	1.8M 4.7M	2.2M 5.6M	1/4 WATT 5% — 50 PCS.

SPECIAL

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$7.49 ea.**

$5.00 Minimum Order — U.S. Funds Only
California Residents — Add 6% Sales Tax

Spec Sheets - 25¢ — Send 35¢ Stamp for 1977A Catalog
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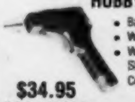
PHONE ORDERS WELCOME — (415) 592-8097
All Advertised Prices Good Thru July

J1

WIRE WRAP CENTER
HOBBY-WRAP TOOL-BW-630



- Battery Operated (Size C)
- Weighs ONLY 11 Ounces
- Wraps 30 AWG Wire onto Standard DIP Sockets (.025 inch)

Complete with built-in bit and sleeve

$34.95
(batteries not included)

WIRE-WRAP KIT — WK-2-W
WRAP • STRIP • UNWRAP

- Tool for 30 AWG Wire
- Roll of 50 Ft. White or Blue 30 AWG Wire
- 50 pcs. each 1", 2", 3" & 4" lengths — pre-stripped wire.

$11.95

WIRE WRAP TOOL WSU-30
WRAP • STRIP • UNWRAP - $5.95

WIRE WRAP WIRE — 30 AWG

25 ft. min. $1.25 50 ft. $1.95 100 ft. $2.95 1000 ft. $15.00
SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

Plastic Push Button Switch

- * 18 AWG Solid Wire - 5" Long
- * .50 (wide) X .50 (high) ¼-27 Thread
- * 8 AMP @ 14 Volt - 1 AMP @ .18 Volt

		1-9	10-Up
J-188-1	Push On-Push Off	.59	.49
J-188-2	Normally Open	.59	.49
J-188-3	Normally Closed	.59	.49

DIP SWITCHES
SPST Slide Action

#206-4	(8 pin dip)	4 switch unit	$1.75 ea.
#206-7	(14 pin dip)	7 switch unit	$1.95 ea.
#206-8	(16 pin dip)	8 switch unit	$2.25 ea.

TV GAME CHIP SET — $18.50

Includes AY-3-8500-1 chip and 2.010 mhz crystal — if purchased separately would cost $21.90.

ZENERS — DIODES — RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3.3	400mm	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N751A	5.1	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N3600	50	200m	6/1.00
1N754	6.8	400m	4/1.00	1N4148	75	10m	15/1.00
1N959	8.2	400m	4/1.00	1N4154	35	10m	12/1.00
1N965B	15	400m	4/1.00	1N4305	75	25m	20/1.00
1N5232	5.6	500m	.28	1N4734	5.6	1w	.28
1N5234	6.2	500m	.28	1N4735	6.2	1w	.28
1N5235	6.8	500m	.28	1N4736	6.8	1w	.28
1N5236	7.5	500m	.28	1N4738	8.2	1w	.28
1N456	25	40m	6/1.00	1N4742	12	1w	.28
1N458	150	7m	6/1.00	1N4744	15	1w	.28
1N485A	180	10m	6/1.00	1N1183	50 PIV	35 AMP	1.60
1N4001	50 PIV	1 AMP	12/1.00	1N1184	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	1N1185	150 PIV	35 AMP	1.50
1N4003	200 PIV	1 AMP	12/1.00	1N1186	200 PIV	35 AMP	1.80
1N4004	400 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR	$1.95
C38M	35A @ 200V	SCR	1.95
2N2328	1.6A @ 200V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC.	1.95

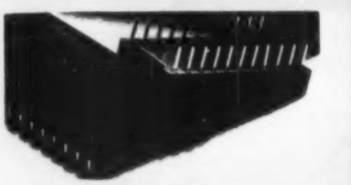
TRANSISTORS

MPS A05	5/$1.00			PN4249	4/$1.00
MPS A06	5/$1.00			PN4250	4/$1.00
2N2219A	3/$1.00	PN3567	3/$1.00	2N4400	4/$1.00
2N2221	4/$1.00	PN3568	4/$1.00	2N4401	4/$1.00
2N2222A	5/$1.00	PN3569	4/$1.00	2N4402	4/$1.00
2N2369	5/$1.00	2N3704	5/$1.00	2N4403	4/$1.00
2N2369A	4/$1.00	2N3705	5/$1.00	2N4409	5/$1.00
2N2484	4/$1.00	2N3706	5/$1.00	2N5086	4/$1.00
2N2906A	4/$1.00	2N3707	5/$1.00	2N5087	4/$1.00
2N2907A	5/$1.00	2N3711	5/$1.00	2N5088	4/$1.00
2N2925	5/$1.00	2N3724	$ .65	2N5089	4/$1.00
2N3053	3/$1.00	2N3725	$1.00	2N5129	5/$1.00
2N3055	$ .89	2N3903	5/$1.00	2N5138	5/$1.00
MJE3055	$1.00	2N3904	4/$1.00	2N5139	5/$1.00
MJE2955	$1.25	2N3905	4/$1.00	2N5209	5/$1.00
2N3392	5/$1.00	2N3906	4/$1.00	2N5951	5/$1.00
2N3398	5/$1.00	2N4013	3/$1.00	C106B1SCR	2/$1.00
		2N4014	3/$1.00	2N6432	$2.00
		2N4123	10/$1.00		

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

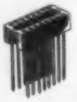
	1-9	10-49	50-100		1-9	10-49	50-100
10 pf	.05	.04	.03	.001µF	.05	.04	.035
22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.022µF	.06	.05	.04
220 pf	.05	.04	.03	.047µF	.06	.05	.04
470 pf	.05	.04	.035	.1µF	.12	.09	.075
100 VOLT MYLAR FILM CAPACITORS							
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22
+20% DIPPED TANTALUMS (SOLID) CAPACITORS							
.1/35V	.28	.23	.17	1.5/35V	.30	.26	.21
.15/35V	.28	.23	.17	2.2/25V	.31	.27	.22
.22/35V	.28	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.28	.23	.17	4.7/25V	.32	.28	.23
.47/35V	.28	.23	.17	6.8/25V	.36	.31	.25
.68/35V	.28	.23	.17	10/25V	.40	.35	.29
1.0/35V	.28	.23	.17	15/25V	.63	.50	.40
MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS							
Axial Lead				**Radial Lead**			
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.15	.13	.10	1.0/16V	.15	.13	.10
4.7/25V	.16	.14	.12	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26



High quality sockets for IC's and PC interconnections. Check our price and quality and you will see why TRI-TEK is fast becoming the leader in IC sockets.

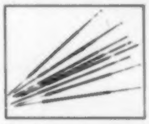
Low Profile DIP Solder Tail (Tin)

	1-9	.10-24	25-100
SKT-0802 8 pin	.15	.15	.14
1402 14pin	.18	.17	.16
1602 16pin	.20	.19	.18
1802 18pin	.27	.26	.25
2002 20pin	.29	.28	.27
2202 22pin	.35	.34	.33
2402 24pin	.36	.35	.34
2802 28pin	.42	.41	.40
4002 40pin	.60	.57	.53



3 Level Wire Wrap Gold

	1-9	10-24	25-100
SKT-1400	.38	.37	.36
1600	.42	.41	.40
1800	.73	.65	.59
2400	1.00	.91	.83
4000	1.69	1.51	1.37



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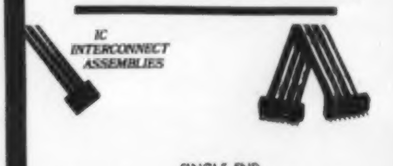
Length	Price per tube of 100	Price per bag of 1000
1"	$1.48 (WW30VC-1)	$11.84 (#WW30BK-1)
2"	$1.60 (WW30VC-2)	$12.80 (#WW30BK-2)
4"	$1.85 (WW30VC-4)	$14.80 (#WW30BK-4)
6"	$2.20 (WW30VC-6)	$17.60 (#WW30BK-6)

ROLLS OF WIRE SAME AS ABOVE (30 ga. KYNAR)
100 ft...$2.95 500ft....$8.95 1000ft...$14.95



SINGLE END

No Of Pins	6"	12"	18"	24"	36"	48"
14P	1.51	1.62	1.72	1.83	2.05	2.26
16P	1.64	1.76	1.87	1.99	2.21	2.44
24P	2.49	2.69	2.88	3.08	3.48	3.87
DOUBLE END						
14P	2.76	2.87	2.97	3.08	3.30	3.51
16P	3.01	3.13	3.24	3.36	3.58	3.81
24P	4.55	4.75	4.94	5.14	5.54	5.93

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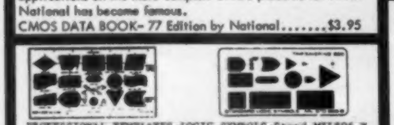

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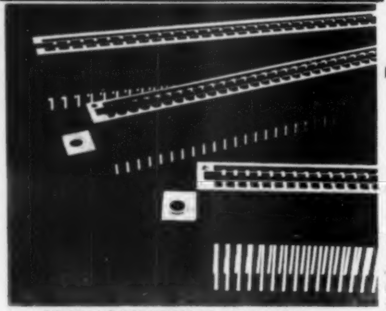

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2X50 with .125" spacing. Solder tail or wrap terminals. By TI.
PCC-100ST (solder)....$4.99 PCC-100WW....$4.99 4/$17.75

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These quality units are faster and have greater fan-out capability than standard TTL. From a giant factory change-over you get real bargain prices. All are house numbered, but we provide a reference and pin-out sheet.
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N8202A...10 bit "D" type register.......... $1.25

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2N3414.. NPN switch on reels.................10/$1
1N753A.. 6.2V, 5%, ¼W Zener.................. 5/$1
C106F2.. 50V, 4A SCR w/socket................ 3/$1
1N967B.. 18V, 5%, ¼W Zener................... 5/$1
42501-1 Quad Hi speed NPN transistor in 14 pin DIP package. Similar to Motorola MPQ3303....... 5/$1

MCM6571A is an 8192-Bit Horizontal-Scan (Row select) character generator with shifted characters. It contains 128 characters in a 7X9 matrix, and has the capability of shifting certain characters that normally extend below the baseline, such as j,y,g,p and q. A 7-bit address code is used to select one of the characters.
Features:
.Static operation
.TTL compatability
.CMOS compatability (5V)
.Shifted character compatability
.Includes Greek alphabet
.Maximum access time =500nS
(See article in March '77 issue of 73 Magazine for applications including TV-Computer interface)
MCM6571A.................................. $9.95
Specs..................................... $1.00

MM5320 TV SYNC GENERATOR I.C.
Generate all the sync pulses necessary for camera or video terminals. Use with MCM6571A in the TV-Computer interface. MM5320N..............................$18.80
Specs.. 60¢

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SC45E 500V, 10A Stud Triac.................. $1.59
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TIP-30 40V, 1 amp PNP Plastic................. 50¢
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Used with motor control to adapt to variable input and noise levels. Applications include zero crossing switch, motor control, tachometers, motor testing.
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2N2369 High Speed NPN switching transistor. Marked for a giant computer company with house number. TO-18 metal case. PRIME PARTS!!!!
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2N3902. High voltage NPN. VCEX=700V, VCEO=400V, IC=3.5A, PD=100W.
2N3902...SUPER SURPLUS BARGAIN!!!..........$3.00

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MC14411 BIT RATE GENERATOR.
Single chip for generating selectable frequencies for equipment in data communications such as TTY, printers, CRT s or microprocessors. Generates 14 different standard bit rates which are multiplied under external control to 1X, 8X, 16X or 64X initial value. Operates from single +5 volt supply. MC14411.......................... $11.98
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2½" round speaker, 8 Ohms	$1.00
2½" round speaker, 100 Ohms	.75
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2N2483	.34
2N2484	.45
2N2905	.35
2N2907	.25
2N2926G	.24
2N2926Y	.24
2N3053	.50
2N3390	.75
2N3439	1.59
2N3440	1.10
2N3512	1.15
2N3553	1.40
2N3565	.22
2N3584	2.30
2N3638A	.37
2N3646	.27
2N3713	1.35
2N3725A	1.80
2N3771	2.50
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2N3924	1.80
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2N5016	17.60
2N5090	7.50
2N5129	.40
2N5179	.90
2N5306	.50
2N5457	.50
2N5458	.50
2N5913	1.70
2N3926	6.30
2N4041	7.80
2N4249	.25
2N4400	.60
2N4402	.25
2N4403	.25
2N4409	.19
2N4427	1.35
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STOPWATCH HAND CASE for above $3.95

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KIT ONLY	$29.95
Three or more kits	27.95
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12 OR 24 HOUR CLOCK KIT. Comes with Big 0.5 Seven Segment LEDs. Uses National 5314 Clock Chip. Fits our Walnut Grain or Plexiglas Cabinets. ONLY $18.95

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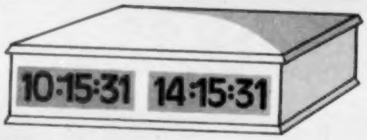

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Six big .5 display LEDs in an attractive black plastic cabinet with a red front filter. Great for a ham or broadcast station. Set one clock to GMT the other to local time. Or have a 24 hour format on one clock and 12 hour on the other. Freeze feature lets the clock be set to the second. Each clock is controlled separately. Cabinet measures 2¼" x 4½" x 9¾". Complete Kit $44.95.

MODEL ALD7:
Four bright .3 nixie tube display. Cabinet is an attractive deep blue including front filter. Will display seconds at the push of a button. An asset to any station. Cabinet size is 2¼" x 3" x 9¾". Complete Kit $34.95.

ALDELCO

2281A BABYLON TURNPIKE, MERRICK NY 11566
516-378-4555

S. D. SALES CO.

P.O. BOX 28810 - A
DALLAS, TEXAS 75228

JUMBO LED CAR CLOCK

$16.95 KIT

50,000 Satisfied Clock Kit Customers Can't Be Wrong!

ALARM OPTION – $1.50
AC XFMR – $1.50

The Hottest Selling Kit We Ever Produced!

You **requested it!** Our first D.C. operated clock kit. Professionally engineered from scratch. Not a makeshift kluge as sold by others.

Features:
- A. Bowmar Jumbo .5 inch LED array.
- B. MOSTEK – 50250 – Super Clock Chip
- C. On board precision crystal time base.
- D. 12 or 24 hour Real Time Format.
- E. Perfect for cars, boats, vans, etc.
- F. P.C. Board and all parts (less case) included.

Specials!

3.579545 MHZ Time Base Crystal $1.25

39 MFD 16V Mallory Electrolytic 15 for $1.

28 PIN IC Sockets 3/$1.00

11,000 MFD 50WVDC Computer Grade Cap - $3.

1702A 2K EPROM

We tell it like it is! We could have said these were factory new, but here is the straight scoop. We bought a load of new computer gear that contained a quantity of 1701 A's in sockets. We carefully removed the parts, verified their quality, and are offering them on one heck of a deal. First come, first served. Satisfaction Guaranteed! U. V. Eraseable. (2.3 US access time.) NEW PRICE!

$2.95 each

UP YOUR COMPUTER!

21L02-1 1K LOW POWER 500 NS STATIC RAM

Time is of the essence!

And so is power. Not only are our RAM's faster than a speeding bullet but they are now very low power. We are pleased to offer prime new 21L02-1 low power and super fast RAM's. Allows you to STRETCH your power supply farther and at the same time keep the wait light off!

8 for $12.95

60HZ Crystal Time Base

$5.95 2/$10.

FEATURES:
- A. 60HZ output with accuracy comparable to a digital watch.
- B. Directly interfaces with all MOS clock chips.
- C. Super low power consumption (1.5MA typ.)
- D. Uses latest MOS 17 stage divider IC.
- E. Elimiates forever the problem of AC line glitches.
- F. Perfect for cars, boats, campers, or even for portable clocks at ham field days.
- G. Small size; can be used in existing enclosures.

Kit includes Crystal, Driver IC, PC board, plus all necessary parts and specs. At last count – over 20,000 sold!

S.D. Sales Exclusive!

$12.95 *S. D. Sales Exclusive!* $12.95

MOS 6 DIGIT UP–DOWN COUNTER

40 PIN DIP. Everything you ever wanted in a counter chip. Features: Direct LED segment drive, single power supply (12 VDC TYPE), six decades up/down, pre-loadable counter, separate pre-loadable compare register with compare output, BCD and seven segment outputs, internal scan oscillator, CMOS compatible, leading zero blanking, 1MHZ. count input frequency. Very limited quantity!

IC's from XEROX

7400 – 9c
7402 – 9c
7404 – 9c
7406 – 11c
7407 – 11c
7410 – 9c
7416 – 13c
7420 – 9c

7430 – 9c
7440 – 9c
7437 – 10c
7438 – 10c
7451 – 9c
7474 – 16c
7475 – 24c
7486 – 16c

7493 – 26c
74121 – 22c
74123 – 32c
74151 – 22c
74155 – 22c
74193 – 35c
8233 – 35c
Intel – 1302 – 45c

1402A–Shift Register–50c
MH0026CN – 55c

IC'S REMOVED FROM PC BOARDS ALL TESTED: FULL SPEC.

1000 MFD

Filter Caps

Rated 35 WVDC Upright style with PC leads. Most popular value for hobbyists. Compare at up to $1.19 ea. from franchise type electronic parts stores.

4/$1.00

SLIDE SWITCH Assortment

Our best seller. Includes miniature and standard sizes; single and multiposition units. All new, first name brand. Try one package and you'll reorder more! Special!

12/$1.00

POWER RESISTOR 15 OHM 25W BY CLAROSTAT

75¢ ea.

RESISTOR ASSORTMENT

¼W 5% & 10%. PC leads. A good mix of values.

200/$2.

P.C. LEAD DIODES

1N4148/1N914
100/$2.00
1N4002 - 1A
100 PIV

40/$1.

Transistor Grab Bag no. 1

Just received a good, mixed lot of National TO92 plastic transistors. PNP & NPN, even a few FET's. 40 to 50% Yield. Untested. Asst.

500/$3.

DISC CAP ASSORTMENT

PC leads. At least 10 different values. Includes: .001, .01, .05 plus other standard values.

60/$1.00

SIX DIGIT ALARM CLOCK KIT

$9.95 KIT

P.C. Board – $3.00
AC XFMR – $1.50

Do not confuse with Non-Alarm kits sold by our competition! Eliminate the hassle – avoid the 5314!

WE MADE A FANTASTIC KIT EVEN BETTER. REDESIGNED TO TAKE ADVANTAGE OF THE LATEST ADVANCES IN I.C. CLOCK TECHNOLOGY. FEATURES: LITRONIX DUAL ½" DISPLAYS, MOSTEK 50250 SUPER CLOCK CHIP, SINGLE I.C. SEGMENT DRIVER, SCR DIGIT DRIVERS. GREATLY SIMPLIFIED CONSTRUCTION. MORE RELIABLE AND EASIER TO BUILD. KIT INCLUDES ALL NECESSARY PARTS (except case). P.C.B. OR XFMR OPTIONAL.

NEW! WITH JUMBO LED READOUTS!

MOTOROLA SCR

2N4443. 8 AMP 400 PIV. P.C. Leads. $3/$1.00

FAIRCHILD - TBA 641

4W. Audio power Amp. Just out! In special heat sink DIP. One super audio IC. $1.50 with data

AC LINE FILTER

Rated 3 AMPS – 115/230V 50 to 400 HZ. Noise Proof Your Computer $3.00 each

GRAB BAG NUMBER 2

Mixed Motorola TO-18 case metal transistors. About 60% yield. PNP & NPN. Untested. A good assortment! 100 for $3.00

PRICES SHOWN SUBJECT TO CHANGE WITHOUT NOTICE.

COMPUTER POWER SUPPLY

Price Cut! ~~$15.95~~ **$12.**

A very fortunate purchase. One of the best industrial quality REGULATED supplies we have seen. High performance, small size. Input is 120VAC 60HZ. Has the following regulated outputs: –5VDC@800MA; –15VDC@1.25AMP; –25VDC@180MA. Sold at a fraction of original cost. Do yourself a favor and order NOW.

AMD – 1702A

Factory Prime Units – Brand New – 1.5 Micro-seconds Access Time. – $4.95 each 10 FOR $40. HUGE FACTORY DIRECT PURCHASE!

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Actually an AC adapter for calculators. 9VDC-no load. 6VDC@200MA. 4VDC@375MA

$2. ea.

S.D. SALES CO.
P.O. BOX 28810 – A
DALLAS, TEXAS 75228

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(Toll Free)

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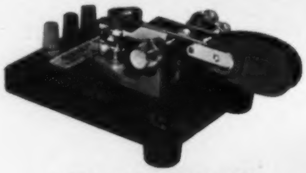
NOW 5 MODELS

- Iambic circuit for squeeze keying.
- Self completing dots & dashes
- Dot memory.
- Battery operated with provision for external power.
- Built-in side-tone monitor.
- Speed, Volume, tone & weight controls.
- Grid-block or direct keying.
- Use with external paddle such as HK-1.

NEW

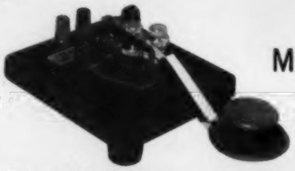
MODEL HK-5
ELECTRONIC KEYER
$69.95



MODEL HK-1

$29.95

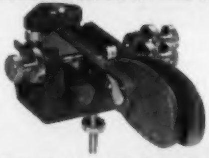
- Dual lever squeeze paddle.
- Use with HK-5 or any electronic keyer.
- Heavy base with non-slip rubber feet.
- Paddles reversible for wide or close finger spacing.



MODEL HK-3

$16.95

- Deluxe straight key.
- Heavy base, no need to attach to desk.
- Velvet smooth action.



MODEL HK-2

$19.95

- Same as HK-1, less base for those who wish to incorporate in their own Keyer.

MODEL HK-4

$44.95

- Combination HK-1 & HK-3 on same base.

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H2

DIODES/ZENERS

1N914	100v	10mA	.05
1N4004	400v	1A	.08
1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.03
1N753A	6.2v	z	.25
1N758A	10v	z	.25
1N759A	12v	z	.25
1N4733	5.1v	z	.25
1N5243	13v	z	.25
1N5244B	14v	z	.25
1N5245B	15v	z	.25

SOCKETS/BRIDGES

8-pin	pcb	.25	ww	.45
14-pin	pcb	.25	ww	.40
16-pin	pcb	.25	ww	.40
18-pin	pcb	.25	ww	.75
22-pin	pcb	.45	ww	1.25
24-pin	pcb	.35	ww	1.25
28-pin	pcb	.35	ww	1.45
40-pin	pcb	.50	ww	1.95

Molex pins	.01	To-3 Sockets	.25
2 Amp Bridge		100-prv	1.20
25 Amp Bridge		200-prv	1.95

TRANSISTORS, LEDS, etc.

2N2222	NPN			.15
2N2907	PNP			.15
2N3740	PNP	1A	60v	.25
2N3906	PNP			.10
2N3054	NPN			.35
2N3055	NPN	15A	60v	.50
T1P125	PNP	Darlington		.35
LED Green, Red, Clear				.15
D.L.747	7 seg 5/8" high com-anode			1.95
XAN72	7 seg com-anode			1.50
FND 359	Red 7 seg com-cathode			1.25

C MOS

4000	.15
4001	.20
4002	.20
4004	3.95
4006	1.20
4007	.35
4008	1.20
4009	.30
4010	.45
4011	.20
4012	.20
4013	.40
4014	1.10
4015	.95
4016	.35
4017	1.10
4018	1.10
4019	.70
4020	.85
4021	1.35
4022	.95
4023	.25
4024	.75
4025	.35
4026	1.95
4027	.50
4028	.95
4030	.35
4033	1.95
4034	2.45
4035	1.25
4040	1.35
4041	.69
4042	.95
4043	1.25
4044	.95
4046	1.50
4049	.80
4050	.60
4066	1.35
4069	.40
4071	.35
4082	.45

– T T L –

7400	.15
7401	.15
7402	.20
7403	.20
7404	.15
7405	.25
7406	.35
7407	.55
7408	.25
7409	.15
7410	.10
7411	.25
7412	.30
7413	.45
7414	1.10
7416	.25
7417	.40
7420	.15
7426	.30
7427	.45
7430	.15
7432	.30
7437	.35
7438	.35
7440	.25
7441	1.15
7442	.55
7443	.85
7444	.45
7445	.80
7446	.95
7447	.95
7448	.95
7450	.25
7451	.25
7453	.20
7454	.25
7460	.40
7470	.45
7472	.45

7473	.25
7474	.35
7475	.35
7476	.30
7480	.55
7481	.75
7483	.95
7485	.95
7486	.30
7489	1.35
7490	.55
7491	.95
7492	.95
7493	.40
7494	1.25
7495	.60
7496	.80
74100	1.85
74107	.35
74121	.35
74122	.55
74123	.55
74125	.45
74126	.35
74132	1.35
74141	1.00
74150	1.00
74151	.75
74153	.95
74154	1.05
74156	1.15
74157	.65
74161	.85
74163	.95
74164	.60
74165	1.50
74166	1.35
74175	.80

74176	1.25
74180	.85
74181	2.75
74182	.95
74190	1.75
74191	1.35
74192	1.65
74193	.85
74194	1.25
74195	.95
74196	1.25
74197	1.25
74198	2.35
74221	1.00
74367	.85
75108A	.35
75110	.35
75491	.50
75492	.50
74H00	.25
74H01	.25
74H04	.25
74H05	.25
74H08	.35
74H10	.35
74H11	.25
74H15	.30
74H20	.30
74H21	.25
74H22	.40
74H30	.25
74H40	.25
74H50	.25
74H51	.25
74H52	.15
74H53J	.25
74H55	.25

74H72	.55
74H101	.75
74H103	.75
74H106	.95
74L00	.35
74L02	.35
74L03	.30
74L04	.35
74L10	.35
74L20	.35
74L30	.45
74L47	1.95
74L51	.45
74L55	.65
74L72	.45
74L73	.40
74L74	.45
74L75	.55
74L93	.55
74L123	.55
74S00	.55
74S02	.55
74S03	.40
74S04	.35
74S05	.35
74S08	.35
74S10	.35
74S11	.35
74S20	.35
74S40	.25
74S50	.25
74S51	.45
74S64	.25
74S74	.40
74S112	.90
74S114	1.30

74S133	.45
74S140	.75
74S151	.35
74S153	.35
74S157	.80
74S158	.35
74S194	1.05
74S257(8123)	.25
74LS00	.45
74LS01	.45
74LS02	.45
74LS04	.45
74LS05	.55
74LS08	.45
74LS09	.45
74LS10	.45
74LS11	.45
74LS20	.40
74LS21	.25
74LS22	.25
74LS32	.40
74LS37	.40
74LS40	.55
74LS42	1.75
74LS51	.65
74LS74	.75
74LS86	.75
74LS90	1.30
74LS93	1.00
74LS107	.95
74LS123	1.00
74LS151	.75
74LS153	1.20
74LS157	.85
74LS164	1.90
74LS367	.85
74LS368	.70

9000 SERIES

9301	.85
9309	.35
9322	.85
95H03	.55
9601	.75
9602	.50

MEMORY CLOCKS

74S188 (8223)	3.00
1702A	7.95
MM5314	3.00
MM5316	3.50
2102-1	1.75
2102L-1	1.95
TMS6011NC	6.95
8080AD	15.00
8T13	1.50
8T23	1.50
8T24	2.00
2107B-4	4.95

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8266	.35
8836	.95
MCT2	.95
8038	3.95
LM201	.75
LM301	.25
LM308 (Mini)	.75
LM309H	.65
LM309K(340K-5)	.85
LM310	1.15
LM311D(Mini)	.75
LM318 (Mini)	.65

LM320K5 (7905)	1.65
LM320K12	1.65
LM320T12	1.25
LM320T15	1.65
LM339	.95
7805 (340T-5)	.95
LM340T-12	1.00
LM340T-15	1.00
LM340T-18	1.00

LM340T-24	.95
LM340K-12	2.15
LM340K-15	1.25
LM340K-18	1.25
LM340K-24	.95
LM373	2.95
LM380	.95
LM709(8,14 PIN)	.25
LM711	.45

LM723	.50
LM725	1.75
LM739	1.50
LM741 8-14	.20
LM747	1.10
LM1307	1.25
LM1458	.95
LM3900	.50
LM75451	.65
NE555	.50
NE556	.95
NE565	.95
NE566	1.75
NE567	1.35
SN72720	1.35
SN72820	1.35

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50-ft. $1.98
For mikes, stereos; 1-cond. plus shield, 22 ga, vinyl jacket. Wt. 1 lb. 7A3577

BARREL KIT #230 HALF INCH READOUTS
7A3629
15 for $1.98
From factory to you! Includes Fairchild FND-500 & 507's.

BARREL KIT #225 SOUND TRIGGERS
3 for $1.98 8 ozs.
"Hand clap" sensitizes crystal mike amplifier, triggers SCR. Cat. No. 7A3625

BARREL KIT #221 IC SOCKETS
8 for $1.98 hobby
Mfr unloads! Four 14-pin, four 18-pin. Solder tail, lo-profile. No. 7A3621

MIXED READOUTS
15 for $1.98 KIT #219
Barrels of untested .17", .3", .5", 7-segs. Like FND-357, 500, 503, MAN-3's. Wut a buy! No. 7A3619

BARREL KIT #205 MINI BLOCK CAPACITORS
50 for $1.98
Unbelievable! Worth $50. High precision submini caps for all applications. Wt. 3 ozs. Cat. 7A 1526

BARREL KIT #203 CALCULATOR KEYBOARDS
10 for $1.98
It's true! 20-key, 4 function keyboards at ridiculous give-away. Wt. 12 ozs. Cat. No. 7A3524

BARREL KIT #210 GLOWIN' PANELS
3 for $1.98
4" x 1" panels that glow blue-green with 110VAC. Use for nite lites, indicators, etc. Cat. No. 7A3550

100 for $1.98 KIT #202 **PLUGS, SOCKETS**
Distributor unloads! Includes AC, DC, RF, audio, 4-9 pin, all kinds. Wt. 1 lb. Cat No. 7A3527

BARREL KIT #201 6V INDICATORS w/leads
15 for $1.98
Test lamp manufacturer dumps inventory! Worth 69¢ ea. Like grain-o-wheat. Cat. No. 7A 3526 hobby

BARREL KIT #200 9 DIGIT READOUT MODULES
5 for $1.98 with calculator driver chips beneath epoxy Cat. No. 7A 3515

BARREL KIT #198 TRANSISTORS & DARLINGTONS
50 for $1.98
Motorola dumps 1,000,000 TO-220 in barrels. NPNs & PNPs. Cat. No. 7A3533

BARREL KIT #191 CARBOFILM RESISTORS
800* for $1.98
*½ pound, approx. ⅛, ¼ watters. Asst values. Unmarked. Cat. No. 7A3445

BARREL KIT #188
400 Parts $1.98
Includes resistors, caps, transformers, rectifiers, diodes, etc. for p.c. work. Preformed, dumped into barrels by factories. 100%. Cat. No. 7A1401

BARREL KIT #187 AUDIO IC'S
30 for $1.98
National & Sprague, 2 to 4 watters, LM-380, LM-377, 2277, etc. DIPs, some with heat sinks. Untested Cat. No. 7A3392

BARREL KIT #185 PC BOARDS
400 parts $1.98
parts: 50 transistors, 50 s, transformers, 200 stors, diodes, etc. %. Cat. No. 7A3386

BARREL KIT #184 ¼-WATT METAL FILM
150 for $1.98
100% metal film resistors. Long leads. 7A3413

BARREL KIT #182 JUMBO RED LEDS
15 for $1.98
100% material, user cancellation from factory dumps, 3V 10 mils. For 100's of projects, red lens. Cat. No. 7A 3369

BARREL KIT #163 MINI TRIM POTS
30 for $1.98 1 oz.
Asst. values 100 to 1 meg What a buy. Single turn. ¼ W. Wt. 6 oz. 7A 3345

BARREL KIT #161 "POP" PLASTIC TRANSISTORS
25 for $1.98
2N3904's with some 2N3906's of 100% material. TO-92. Preformed. Cat. No. 7A 3343 1 oz.

BARREL KIT #160 V. REGULATORS
10 for $1.98 Hobby
No. 7A3330
LM309KC TO-3 V.R.'s barreled. Bot by the pound.

BARREL KIT #159 MODULAR SWITCHES
25 for $1.98
Centralab switches. TV-makers excess. Dpdt, 6pdt, etc. Brand new. Cat. No. 7A 3150

BARREL KIT #158 MAGNIFIED MAN-3's
20 for $1.98
MAN-3. 7-seg rerdout, with built-on magnifier. Factory discontinued line. 100% material. Cat. No. 7A3325 1 oz.

BARREL KIT #155 MOLDED CAPACITORS
75 for $1.98 7A3311
Asst. size voltages, red, green, yellow, blue plastic cases, axial leads. 1 lb.

BARREL KIT #154 CLOCK CHIPS
20 for $1.98 hobby
We gathered an assortment of clock chip, alarm, calendar, beepers, who knows, all mixed. Cat. No. 7A 3308

BARREL KIT #145 MINI TRANSFORMER
15 for $1.98 outputs, interstage and audio. Only 1" sq. Wt. 2 lbs. 7A 3294

BARREL KIT #144 RCA PHONO PLUGS
40 for $1.98
1,000,000 RCA phono plugs for this one. You hi-fi-ers know wut they are . . . 100% material. 7A 3293

BARREL KIT #138 PANEL SWITCHES
30 for $1.98
Did you hear of OAK? Another eqpt maker barrelled all types of rotaries, electric, slides, etc. 7A 3268

BARREL KIT #135 MICRO MINI LAMPS
20 for $1.98 1 oz.
Imagine! Micro size (¼ x ¼) with wire leads, 3 to 5 VDC, 40 mils. 7A 3259

BARREL KIT #128 MINI DIP ICS
100 for $1.98
Large mfgr dumped 100's of lbs into barrels. Includes 741s, LM-380-8, 703, 567, 555, 558—but who knows? Wt 1 lb. 7A 3245 hobby

BARREL KIT #127 AXIAL ELECTROS
40 for $1.98
Asst. capacities and voltages. Cat. No. 7A 3227

BARREL KIT #126 UPRIGHT ELECTROS
40 for $1.98
1mf to 300mf in mixture of voltages. 100% marked 'n good. 7A 3226

BARREL KIT #118 MINI SCRS
50 for $1.98
UNBELIEVABLE! TO-92 plastic SCRS in barrels . . . rite from factory. Includes all voltages up thru 200 prv. 7A 3135

BARREL KIT #117 OPTICAL FIBERS 2 ozs. **20-MIL**
7A3206
200-FT. $1.98
Fiber optics factory bankruptcy purchase! High quality, most-commonly used size (20-mil). CLEAR.

BARREL KIT #115 MOLEX SOCKETS 100% good
200 for $1.98 Cat. No. 7A 3144
Calculator maker dump! We gut a zillion of 'em.

BARREL KIT #112 MICRO MINI LEDS
40 for $1.98 Hobby
All the tiny leds, axial, upright of Monsanto, Litronix, variety of colors. Yield 50% or better. 7A 3139

BARREL KIT #109 TERMINAL STRIPS
100 for $1.98
Wide asst. of terminal strip connectors, from 1 contact up. Strip manufacturers barrel dump is your gain. Wt. 1 lb. Cat. No 7A 3136

BARREL KIT #108 TO-5 PLASTIC TRANSISTORS
Cat. No. 7A 3101
40 for $1.98
Includes PNP, NPN, 2N-3638, 2N3641, 2N5000 series, etc. Untested.

BARREL KIT #104 SLIDE VOLUME CONTROLS
10 for $1.98
Cat. No. 7A 1057

BARREL KIT #101 RESISTOR SPECIAL
200 for $1.98
Includes: ⅛, ¼, ½, 1, 2-watters, carbon. 8 oz. 100% good. 7A 3054

BARREL KIT #99 PHOTO ELECTRIC CELLS
10 for $1.98
Asst. GE types, CDS types. Mixed by factory. Big job for us to separate. 100% good. Cat. No. 7A 1052

BARREL KIT #93 HALF WATTERS
200 for $1.98
Resistor factory tried to fool us by mixing 100% color-coded resistors in barrel. But value is there. 4 oz. 7A 3046 Untested

BARREL #91 SILVER MICAS
100 for $1.98
Axial, red case, variety of physical sizes & values. Cat. No. 7A 3018

BARREL KIT #88 LITRONICS LED READOUTS
10 for $1.98
Hobby singles, triples, etc. .33 to 0.6. Bot from factory, all mixed: have fun! No. 7A2861

BARREL KIT #87 NATIONAL IC BONANZA
100 for $1.98
Types 8000, 7400 series, DTLs, ROMs, registers, clock & calc. chips, linears, etc. Cat. No. 7A 2860 Untested.

BARREL KIT #86 HOBBY LEDS
40 for $1.98 Untested
747's, 727's, singles, triples, etc. .33 to 0.6. Bot from factory, all mixed; have fun! 7A 2859

BARREL KIT #83
15 for $1.98
LM-340T VOLT REG
Factory rejected them for length of leads. May include 5, 6, 8, 12, 15, 18, 24 volts. Power tab Cat. 7A 2635

BARREL KIT #81 SUBMINI RESISTORS
200 for $1.98
PC, upright type, color coded, ⅛ watt. Asst values. Came to us in a barrel. Cat. No 7A 2746 100% good.

BARREL KIT #76 1-WATT ZENERS
100 for $1.98
Factory same as 400-mw's. Never-to-see-again offer. 6, 8, 10, 12, 15V. under glass. Double plug. Cat. No. 7A 2741 Untested.

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The brightest clock made! Uses 7 segment GE tube readouts. Includes famous MM5316 clock chip and a minimum of components! Easy and fun to build, perfect for the new hobbyist! 12 hour display, (24 hour cycle), AM-PM indicator. Options include clock radio timer, 60 minute sleep timer, and snooze. PC board not included. Easy to breadboard, with instructions. Requires 12 V transformer, see our 92CU3412.

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Easy and fun to build! 6 digit display time in hours, minutes and seconds. 12 hour format, 24 hour cycle. 7 minute snooze. Uses famous MM5375AB and a minimum of components. Controls for slow and fast set, and reset to zero. Includes all necessary components except for case, line cord, PC board. Requires 12V Transformer, see our Catalog #92CU3412. PC boards available, write or call for information. Wt. 8 ozs.
Cat. No. 7A 3793 6 Digit LED alarm clock basic kit.

COMPLETE KIT: includes case, transformer and line cord. Cat. No. 7E3505..... ☐ $19.95

4 DIGIT ☐ **$12.95**
Same as our 6 DIGIT LED ALARM CLOCK BASIC, except with .5" digits, displays hours and minutes, blinking colons indicate seconds. Wt. 8 ozs. Cat. No. 7A3794

COMPLETE KIT: includes case, transformer and line cord. Cat. No. 7A3507..... ☐ $19.95

BARREL KIT #73 TRANSISTOR ELECTROS
50 for $1.98
We don't wish to separate wide asst voltages & values up to 300 mf. Cat. 7A 2747

BARREL KIT #71 CAPACITOR SPECIAL
100 pcs. $1.98
micas, moldeds, plastics, ceramics, discs, etc. Nifty 100% good Cat. No 7A 2738

BARREL KIT #68 2 WATTERS
100 for $1.98 100% good.
Suppliers throw 'em in the barrel. It's a li'l gold mine. All marked. Cat. No. 7A 2735

BARREL KIT #65 MIXED READOUTS
10 for $1.98
Factory returns — such numbers as MAN-4's, MAN-7's, MAN-3's, 11 barrels & no time to separate. Hobby Cat. No. 7A 2733 Untested.

BARREL KIT #61 POLYSTYRENE CAPS
100 for $1.98
Finest caps made. As a gamble we bought 10 barrels from factory, mixed values; all good. Cat. No. 7A 2729

BARREL KIT #58 SLIDE SWITCHES
30 for $1.98
All shapes, sizes, spst, dpdt, momentaries, etc. Tremendous shop pak for 100's of switching projects.
Cat. No. 7A 2728 100% good

BARREL KIT #56 POWERS! POWERS!
100 for $1.98 Cat. 7A 2724
Large distributor cleaned house. Barrels of power resistors 3 to 7 watts.

BARREL KIT #54 8 DIGIT READOUTS
10 for $1.98
Bargain of a lifetime! All we got was 1 barrel — the "blisdor digit" types. Multiplexed. Cat. No. 7A 2722

BARREL KIT #40 PNP HIGH-POWER TRANSISTORS
20 for $1.98 Hobby
Popular germanium TO-3 case 7A 2618 100% good

BARREL KIT #39 2N3055 HOBBY TRANSISTORS
15 for $1.98
Fallouts of the famous 2N3055. 7A 2617 100%

BARREL KIT #37 1 AMP "BULLETT" RECTIFIERS Untested
100 for $1.98
Famous style, asstd. voltages, silicon, axial includes all types of voltages to 1KV. Cat. No. 7A2615

BARREL KIT #36 GERMANIUM DIODES Untested
200 for $1.98
Cat. No. 7A 2614
Famous maker, popular item. Never grows old.

BARREL KIT #35 NEON LAMPS
30 for $1.98 100% good.
Famous NE-2's. All prime, but factory made millions and barrel'ed 'em. Your advantage Cat. No 7A 2613

BARREL KIT #31 METALLIC RESISTORS
100 for $1.98
Made mostly by Corning, the finest resistor made. Mostly ½ watters, 1% to 5% tol. & a barrel of values. Cat. No. 7A 2609

BARREL KIT #30 PREFORMED RESISTORS
200 for $1.98
We got barrels of ¼ and ½" watters for pc use. 100: ¼, 100 ½" watters. No. 7A 2608 100% good

BARREL KIT #27 PREFORMED DISCS
150 for $1.98
Hi-Fi mfr's shelf inventory but he dumped 'em in barrels. Preformed, for PC use. Mixed values too! 7A 2605

KIT #26 PLASTIC TRANSISTORS
100 for $1.98 Hobby Untested.
Type TO-92 (TO-18), all manufacturers, variety of 2N #'s. Cat. No 7A 2604

BARREL KIT #25 METAL CAN TRANSISTORS
100 for $1.98
Includes TO-5, TO-1, TO-18, etc., assorted 2N numbers, unmarked etc.
Cat. No 7A 2603 Untested.

BARREL KIT #20 LONG LEAD DISCS
100 for $1.98
"auction sale". Prime, marked only. Long leads Cat. No 7A 2598 100% good

BARREL KIT #19 DIPPED MYLARS
60 for $1.98
Finest capacitors made, shiny finish. Imagine factory dumping 'em in barrels. Cat. No. 7A 2597 100% good

BARREL KIT #17 LINEAR & 7400 DIPS
100 for $1.98 Hobby Untested
Marked and unmarked, internal numbers of raw factory stock. Cat. No 7A 2431

BARREL KIT #15 MOSFET TRANSISTORS
60 for $1.98
All 4 leaders TO-18 case, includes UHF transistors too! Cat. No. 7A 2429

BARREL KIT #14 PRECISION RESISTORS
200 for $1.98
Marked and unmarked ¼, ½, 2 watts. No 7A 2428

BARREL KIT #11 POWER TAB TRANSISTORS
40 for $1.98
NPN, plastic TO220 type. Assorted 2N numbers. No. 7A 2425 Untested.

BARREL KIT #10 ROMS-REGISTERS
75 for $1.98
Untested Hobby
28 to 40 pin devices, marked, internal factory numbers, etc Cat. No. 7A 2424

BARREL KIT #8 SUBMINIATURE IF TRANSFORMERS
75 for $1.98
Amazing, includes 455kcs, osc, antenna, who knows? Cat. No. 7A2422 100% good

BARREL KIT #7 VOLUME CONTROL
30 for $1.98 100% good
Singles, duals, variety of values, styles, big ones — small ones. Cat. No. 7A 2421

BARREL KIT #5 SCRS, TRIACS, QUADRACS
40 for $1.98 Raw factory stock! All the 10 amp types. Cat. No. 7A 2419 Untested.

BARREL KIT #4 "4000" RECTIFIERS
100 for $1.98 Untested.
1N4000 series. May include 25, 50, 100, 200, 400, 600, 800 and 1000 volters. 7A 2417

BARREL KIT #3 1N4148/914 SWITCHING DIODES
100 for $1.98
Imagine famous switching diodes at these prices! Cat. No. 7A 2416 Untested.

BARREL KIT #2 LINEAR OP AMPS, DIPS 75 for
Untested **$1.98**
May include 703's, 741's, 709's, 560 series, 555 includes 7A2416 hobby

BARREL KIT #1 SN7400 DIP IC'S.
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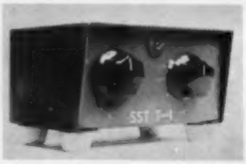

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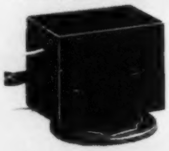

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Social Events

from page 167

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CHENEY WA
JULY 16-17

The Spokane Amateur Radio Council (SARC) will hold its third annual hamfest July 16 and 17, 1977 in the Pence Union Building at Eastern State College, Cheney, Washington, about 15 miles west of Spokane. Pre-registration is $9.50, the same as last year, which includes the banquet on campus and many prizes. Numerous seminars, flea market and activities for YLs, XYLs and MYLs. Make pre-reg checks payable to SARC and mail to Jim Johnson WA7BWO, Drawer "A", Cheney WA 99004.

ALLENTOWN PA
JULY 17

The Tri-Club Hamfest will be held July 17, 1977 from 8 am to 5 pm at the Allentown Police Academy Pistol Range in Scenic Lehigh Parkway South at Allentown PA. Admission is $1.00 to all including sellers. Children are free. Talk-in on .34-.94 and .52.

EAST MCKEESPORT PA
JULY 17

The Two Rivers Amateur Radio Club will hold its 13th Annual Hamfest on Sunday, July 17, 1977 at the Green Valley Fire Department fairgrounds off U.S. Route 30 near East McKeesport. With the expanded parking facilities and the addition of a large flea market area, this event has become one of the largest of its kind in Western Pennsylvania. For more info contact John Roberts WA3SOZ, Secretary, Two Rivers Amateur Radio Club, McKeesport PA 15132.

BOWLING GREEN OH
JULY 17

The Wood County ARC Ham-A-Rama is Sunday, July 17, 1977 from 8:00 am to 5:00 pm, at the County Fairgrounds in Bowling Green, Ohio (about 25 miles south of Toledo). Free parking and admission. Donation $1.50 advance, $2.00 at the door. Tables $2.00. Talk-in on 146.52. Refreshments available. For further info write WCARC, 7929 Rudolph Road, Rudolph, OH 43462.

EUGENE OR
JULY 23-24

The Annual Lane County Ham Fair will be held on July 23-24, 1977 at the Lane County Fairgrounds in Eugene, Oregon. Registration donation will be $2.00. CW contest — fox hunts on 2 meters — swap and shop — commercial displays — prizes — YL craft table. A Saturday banquet at $4 per plate with musical entertainment from 7 pm until midnight. Free parking for RVs with limited free hookups. Advance registration contact Earl E. Hemenway K7KVV, 2366 Madison St., Eugene OR 97405.

SLATER MO
JULY 24

Indian Foothills Amateur Radio Club will hold their Hamfest and Communication Show on July 24, 1977 in Slater, Missouri at the city park. Activities include flea market for OM, flea market for XYL, equipment you wish to display, old — new, prize for best home built, K0RWG and wife musical entertainment, kiddie pool, swimming pool, and tennis courts. Talk-in 94, 52, 28-88, 3963 kHz. For information and registration: R. D. Beilsmith W0KNF, Box 74, Slater MO 65349, phone: (816) 529-2173.

NEENAH WI
JULY 24

The 3-F's A.R.C. Northeast Wisconsin Swapfest will be held Sunday, July 24, 1977 in Neenah, Wisconsin, 0900-1500. This annual event features inside tables, food and refreshments, bar and easy access from U.S. Highway 41. (Take Wisconsin Highway 114 exit east, then take first left to the Neenah Labor Temple at 157 South Green Bay Road.) Dealers will be there, an auction at the end of the day has traditionally offered super deals, and there's a special $3 rate for families. Talk-in on .94/.94. Admission $1.50, tables $2. Send advance reservations to 3-F's, Box 1032, Neenah, Wisconsin 54956.

FLAGSTAFF AZ
JULY 29-31

The Ft. Tuthill Hamfest will be held July 29-31, 1977. Ft. Tuthill is the historical name given to the Coconino County Fairgrounds located on Rt. 89A south of Flagstaff AZ. Hamfest activities include a transmitter hunt on 2 meters, exhibits and demonstrations on many facets of amateur radio. Technical sessions, special contests, and many other interesting activities. Talk-in frequencies will be 146.22/82, 146.52, 3.910 MHz. For more information write Ft. Tuthill Hamfest, PO Box 11642, Phoenix AZ 85061.

OLIVER BC
JULY 30-31

The Okanagan International Hamfest will be held July 30 and 31, 1977 at Gallagher Lake, 8 miles north of Oliver, B.C. Family fun, contests, flea market, and gabfest. KOA campsites available. No inflation prices. Prizes galore. Talk-in 34/94. For more information contact Phil Wilkinson VE7ALV, Naramata, B.C.

FARMINGTON NM
JULY 30-31

The Totah Amateur Radio Club, Inc., will hold its club field day on July 30 and 31, 1977, at the Four Corners National Monument (New Mexico, Arizona, Utah and Colorado). Mode: SSB and CW, bands — 15, 20 and 40. Club station call K5WXI.

NORTH MANKATO MN
JULY 31

The Mankato Area Radio Club will hold its annual picnic, swapfest and auction on July 31, 1977, between 10 am and 4 pm at Spring Lake Park in North Mankato MN. Talk-in 3.93, 146.94 and 146.25/85 MHz. Liquid refreshments will be available; bring your own dinner. For further details write the Mankato Area Radio Club, Box 1961, North Mankato MN 56001 or call Allen Windhorn at (507) 931-1349.

MACS INN ID
AUG 5-7

The 45th Annual WIMU (Wyoming, Idaho, Montana and Utah) Hamfeast is scheduled to be held at Macs Inn, Idaho, just south of West Yellowstone about 25 miles. This is one of the Rocky Mountain Northwest's largest hamfeasts and we would like to invite you to attend, and at the same time enjoy a tour through Yellowstone National Park. Advance registration is $6 (before July 1st). $7 at the Hamfeast. Please send all pre-registrations to WIMU Hamfeast, PO Box 30756, Billings, Montana 59107, c/o Ronald Conley, General Chairman, WIMU Hamfeast.

NEWBURGH NY
AUG 6

The Mt. Beacon Amateur Radio Club will hold their 4th Annual Hamfest on Saturday, August 6th, 9 am to 5 pm, at Stewart Field, Newburgh NY, inside hangar. Flea market and auction. Talk-in on 37/97 and 16/76. Rain or shine. Plenty of free parking. Admission $1, Tailgating $1, under 12 free.

JACKSONVILLE FL
AUG 6-7

The Bold City Hamfest sponsored by the Jacksonville Range Association will be held at the Jacksonville Beach Auditorium August 6-7. Vacation at our Hamfest — Florida's Friendliest. Visit our special "Solar" and "QRPp" forums. Send request for information and tables to Hamfest Coordinator, Jacksonville Range Association, PO Box 10623, Jacksonville FL 32207. For motel reservations call Ramada Inn toll free (800) 228-2828.

OKLAHOMA CITY OK
AUG 6-7

The 1977 Oklahoma Ham-Holiday will be held August 6 and 7, 1977 at the Southgate Inn Best Western, 5245 South Interstate 35, Oklahoma City, (405) 672-5561. Pre-registration $3.00, at the door $4.00.

FORT WAYNE IN
AUG 7

The Orignal FM Hamfest will be held Sunday, August 7, 1977, rain or shine, at the Allen County Police Reserve Center, 3022 Easterday Road, Fort Wayne, Indiana. 5400 square feet of air conditioned exhibit area, hot food and refreshments and prizes. Sponsored by Fort Wayne Repeater Association, Inc. Advanced registration $1.50 — call in to WA9EAU on 146.16/146.76, WR9ADI 146.52 or 52.525 MHz. Tickets at door $2.00. Taped route information available on 146.91 MHz. For more information and advance tickets please write: Fort Wayne Repeater Association, Inc., PO Box 6022, Fort Wayne IN 46806.

ANGOLA IN
AUG 7

The Steuben County Radio Amateurs presents the 19th Annual F.M. Picnic and Hamfest to be held on Sunday, August 7, 1977, at the Steuben County 4-H Park, approximately 2 mi. west and 2 mi. north of Angola, Indiana. Hamfest includes picnic-style B.B.Q. chicken and refreshments, inside tables for exhibitors and vendors, overnight camping permitted in park for those desiring to arrive Saturday, movies Saturday night, as usual. Tickets $1.00 by donation, advance registration not necessary. Talk-in frequencies 52.525, 146.52, 223.5, 446.0.

CANTON OH
AUGUST 7

The Canton, Ohio, Hall of Fame Hamfest (an official ARRL hamfest) will be held at the Stark County Fairgrounds on Sunday, August 7, 1977. Hamfest includes ARRL, Amateur Electronic Supply, Ken-Mar Industries, Omar Electronics, flea market, YL activities including games and drawings. Admission $3 at gate, $2.50 advanced. Under 13 years of age free. For advanced reservations contact: Butch Lebold WA8SHP, Box 3, Sandyville OH 44671. Advanced deadline July 30, 1977. For directions and information call: W8ZX on 146.19/79 (WR8ADE) or W8AL on 146.52/52. Mobile check-in prize!

PITTSBURGH PA
AUG 7

The 40th Annual Hamfest of the South Hills Brass Pounders and Modulators will be held on August 7, 1977 from noon until dusk at St. Clair Beach, Upper St. Clair Township, 5 miles south of Mt. Lebanon, on Rte 19. Swap and shop, picnic space and swimming for the family. Mobile check-in on 29.0 and 146.52. Information and pre-registration at $1.50 per ticket ($2 at door) from Rich Eckenrode, 1410 Bellaire Pl., Pittsburgh PA 15226. Vendors must register.

LEVELLAND TX
AUG 7

The 12th annual West Texas Emergency Net Picnic and Swapfest will be held in the city park, Levelland, Texas on Sunday, August 7. Bring your own picnic basket. Registration begins at 8 am. Lunch at 12:30. Swapping all day. Tables are provided. This family event is jointly sponsored by the Hockley County Amateur Radio Club and the West Texas Emergency Net. Mobile talk-in frequency is on 2 meters only, on 28/88, the Levelland Repeater (WR5AFX). Prizes will be given this year and a $2 donation will be appreciated, but is not required for registration.

WASHINGTON MO
AUG 7

The Zero-Beaters ARC will hold their annual Hamfest on Sunday, August 7, 1977 at Washington, Missouri city park. Free parking, bingo, and many prizes. No admission fee or fee for parking in the trader's row. For info or tickets contact Marvin Holdmeyer WB0VPF, or Zero-Beaters ARC WA0FYA, Box 24, Dutzow MO 63342.

AMARILLO TX
AUG 12-14

The Panhandle Amateur Radio Club of Amarillo, Texas, is sponsoring the 1977 Edition of the Golden Spread Hamfest at the Holiday Inn West, Amarillo, Texas, August 12, 13 and 14. A grand prize and pre-registration prize worth over $800 will be given away. Activities include six big tech and info sessions, commercial exhibitors, flea market, free bingo for all, two hospitality hours, live entertainment, special activities for the ladies, and demonstrations. Pre-registration $3, at the door $4. Write Golden Spread Hamfest, PO Box 10221, Amarillo, Texas 79106 for pre-registration packet.

POLSON MT
AUG 13

Western Montana amateurs will sponsor an annual Mini-Hamfest on Flathead Lake, near Polson, Montana, on August 13, 1977.

CHARLOTTE VT
AUG 13-14

Burlington A.R.C. International Field Day will be held on August 13 and 14, 1977, at Charlotte, Vermont. Flea market both days 7 am Saturday to 5 pm Sunday. $3.00 early bird registration. $3.50 at door – write P.O. Box 312, Burlington, Vermont. Talk-in .01-.61.

PLAIN CITY OH
AUG 14

Union County Amateur Radio Club proudly presents Hamfest 77 to be held on Sunday, August 14, 1977 at Plain City Fairground near Columbus OH on St. Rt. 42, 4 miles south of 33. Hamfest includes large flea market, indoor tables for dealers, food available, free parking, and free overnight camping. Admission $1.50 advance, $2.00 at gate. Talk-in on 146.16/76. Check in (for prize) on 146.52. For more information write: Union County Amateur Radio Club, 13613 U.S. 36, Marysville OH 43040.

FORT WASHINGTON PA
AUG 14

The Mt. Airy VHF Radio Club (the Packrats) is holding its annual family picnic in the Flourtown Area of the Fort Washington State Park on Sunday, August 14, 1977 (rain date August 21). Talk-in W3CCX/3 on 52.525, 146.52, and 222.98/224.58 MHz.

BRISTOL TN-VA
AUG 13-14

The Bristol Amateur Radio Club, Inc., will hold the Bristol Hamfest August 13-14 at the Beacon Drive-In Theatre on Blountville Hwy., 9 am to 5 pm, Saturday, 9 am to 3 pm Sunday. Tickets $1, flea market space $2. Talk-in on 01-61, 28-88 and 3980. Contact Bristol Amateur Radio Club, Paul E. Booher WA4KAS, 1221 Jonesboro Road, Bristol VA 24201.

DESOTA IL
AUG 22

The SARS Hamfest will be held on August 22, 1977, in Desoto, Illinois. Program includes prizes, food, auction. No charge for flea merchants. For more information write Nick Koeningstein, 2009 Gray Dr., Carbondale IL 62901.

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73 Radio Bookshop

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COMPUTERMANIA T.M.

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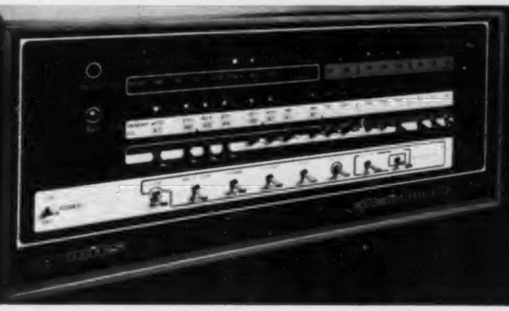

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See dozens of microcomputer systems on display and running . . . sit down and give them a try . . . find out why people get hooked on Star Trek . . . find out why 100,000 computermaniacs have gone nuts over microcomputers. See a couple of hundred exhibits of computers, memory boards, printers, floppy disks – see it all at the Pier this August!

Hear top computerized hams explain about the fun they are having and the fun you can have. This show is worth the trip from anywhere. Charter flights are being organized from the West Coast and Japan.

See the manufacturers show and tell about their systems . . . and answer your questions – in detail. You don't have to be a computer expert to find out how exciting microcomputers are . . . and why they are going to be a multi-billion dollar business before long. One look will convince you.

See Morse code translated into print . . . even into voice . . . all by microcomputer . . . and at a price within reasonable hobby limits. See Oscar data computers . . . repeater control computers . . . all sorts of fantastic ham applications of microcomputers.

Don't miss the fun at the Pier in Boston . . . where calculators . . . TV Games . . . Microcomputers . . . Hobby computer systems . . . ham computer systems . . . and even small business computers you may be able to use in your business will be on display and running for you to try out.

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7–7

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The supply of these back issues is very limited . . . and when these are gone, that will be it. Don't miss out by procrastinating.

Single issues	$1.50 each (before 1976)
Ten back issues (your choice)	$12 postpaid in US.
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Twenty-five back issues (our choice)	$10 postpaid in US.

JUNE 63. Surplus Issue: DMQ-2 Beacon Tx on 220, increasing ARC-2 transceiver selectivity, PE-97A pwr supply conversion, BC-348 bandspread, inductance tester, converting BC-230 tx, beginner's rx using BC-453, recvr motor-tuning, transistor cw monitor, BC-442 ant relay conversion, mobile loading coils, increasing Two-er selectivity, TV with the ART-26 tx, TRC-8 rx on 220, ARC-5 hf rx & tx, ARC-3 tx on 2M.

AUG 63. Battery-op 6M stn, diode noise gen, video modulation, magic T-R switch, ant gain, halo mods, cw breakin, VEE beam design, coax losses, RF wattmeter, TX Tube Guide, diode pwr supply, "Lunchbox" squelch, SWR explanation, vertical ant info, info on Windom ant.

OCT 63. WBFM transceiver ideas, HF propagation, cheap fone patch, remote-tuned Yagi, construction hints, ant coupler, 86 Vertical, filament xformer construction, 2M nuvistor converter, Lafayette HE-35 mods, Buyer's Guide to Rx & Tx, product detector, novel Hi-C VFO, radio astronomy, panadaptor "if" converter, compact mike amp.

FEB 64. 2M multichannel exciter, rx design ideas, majic t/r switch, loudspeaker enclosures, 40M 2W tx, look at test equipment, radio grounds, 40M ZL Special ant, neutralization.

MAY 67. Quad Issue: 432 Quad-quad-quad, expanded HF quad, Two el quad, miniquad, 40M quad, quad experiments, half-quad, three el quad, 20M quad, tiltover quad, easy-to-erect quad, Quad Bibliography, FET vfo, tube troubleshooting, HF dummy load, understanding "dB," HF SSB/cw rx, geometric circuit design, GSB-201 transceive, FET converter for 10-20M, hi-pass rx filters.

JULY 67. VE ham radio, VE8 hams, dsb adaptor, home brew tower, transistor design, '39 World's Fair, gnd plane ant, G4ZU beam, SSTV monitor, UHF FET preamps, IC "if" strip, vertical ant, VHF/UHF dipper, tower hints, scope monitoring, operating desk, S-Line crossband, hi-school ham club, Heath HR-10 mods.

OCT 67. HF solid state rx, rugged rotator, designing slug-tuned coils, FET converter, SSTV pix gen, VHF log-periodics, rotatable dipole, gamma-match cap, old-time dxing, modern dxing.

JUNE 68. Surplus Issue: Transformer tricks, BC-1206 rx, APS-13 ATV tx, low voltage dc supply, surplus scopes, FM rig commercial xtal types, Wilcox F-3 rx, restoring old equipment, 75A1 rx mods, TRA-19 on 432, freq counter uses, transceiver pwr supply, uses for cheap tape recorders, Surplus Conversion Bibliography, RT-209 walkie on 2M, ARC-1 guard rx, RTTY tx TU.

JULY 68. Wooden tower construction, tiltover towers, erecting a telephone pole, IC AF osc, "dB" explained, ham club tips (Part 1).

SEPT 68. Mobile vhf, 432 FET preamps, converting TV Tuners, xtal osc stability, parallel-Tee design, moonbounce rhombic, 6M xciter (corrections Jan 69), 6M transceiver (corrections Jan 69), 2M dsb amp, ham club tips (Part 3).

NOV 68. SSB xtal filters, solid state troubleshooting, IC freq counter (many errors & omissions), "ev" transformers, space comm odyssey, pulsar info, thin-wire ants, 40M transistor cw tx/rx, BC-348M double conversion, multifunction tester, copper wire specs, thermistor applications, hi-voltage transistor list, ham club tips (Part 5).

JAN 69. Suppressor compressor, HW-12 on 160, beam tuning, AC voltage control, 2M transistor tx, LC power reducer, spectrum analysis info, 6M transistor rx, operating console, RTTY autostart, calculating osc stability, lo-pwr 40 cw tx, sequential relay switching, sightless operator's bridge, ham club tips (Part 7).

FEB 69. SSTV camera mod for fast-scan, tri-band linear, selective af filter, unijunction transistor info, Nikola Tesla biography, mobile installation hints, extra-class license study (Part 1).

MAR 69. Surplus issue: TCS tx mods, cheap compressor/amp, RXZ calculations, transistor keyer, better balanced modulator, transistor oscillators, using blowers, halfwave feedline info, Surplus Conversion Bibliography, extra license study (Part 2).

APR 69. 2-channel scope amp, rx preamp, Two-er PTT, variable DC load, SWR bridge, 100 kHz marker gens, some transistor specs, SB-610 monitorscope mods, portable 6M AM tx, 2M converter, extra license study (Part 3).

MAY 69. 2M Turnstile, 2M Slot, rx attenuator, generator filter, short VEE, quad tuning, using antennascope, measuring ant gain, phone patch regs, SWR indicator, 160M short verticals, 15M antenna, HF propagation angles, FSK exciter, KW summy load, hi-power linear, extra license study (part 4), all-band curtain array.

JUNE 69. Microwave pwr generation, 6M ssb tx, 432-er tx/rx, 6M converter, 2M 5/8 wave whip, UHF tv tuners, ATV video modulator, UHF FET preamps, RTTY monitorscope, extra license study (part 5), building uhf cavities, mini-VEE for 10-20M, vhf vfo.

JULY 69. AM modulator, SSTV sig gen, 6M kw linear, 432 KW amp, 432-er tx/rx, 6M IC converter, radio-controlled models, RTTY IC TU, audio notch filter, VRC-19 conversion, tube substitution, 2M transistor xciter, extra license study (part 6), hf FET vfo.

AUG 69. FET regen for 3.5 MHz up, FM crystal switching, 5/8 wave vertical, introduction to ICs, RTTY tone gen, good/bad transistor checker, 2M AM tx, measure transistor Ft, 160M propagation, triac applications, simple IF sweep gen, transistor keyer, SB-100 on 6M, xtal freq measurement, extra license study (part 7), FM deviation meter, qrp am 6M tx, circular quads, FM noise figure, transistor parameter tracer.

SEPT 69. Tunnel diode theory, majic tee, soldering techniques, wave travel theory, cable shielding, transistor theory, AM noise limiter, AFSK gen, transistor amp debugging, measure meter resistance, diode-stack pwr supply, transistor testing, 2½W 6M tx, HX-10 neutralizing, capacitor usage, radio propagation, AM mod percentage, extra class license study (part 8), 3-400Z linear, ATV vidicon camera, 2 transistor testers, FET compressor, rf plate choke.

OCT 69. Super gain 40M ant, FET chirper, telephone info, scope calibrator, thyrector surge protector, slower tuning rates, identify calibrator harmonics, FM adaptor for AM tx, CB sets on 6M, proportional control xtal oven, xtal filter installation, Q-multiplier, transceiver pwr supply, extra class study (part 9).

NOV 69. NCX-3 on 6M, IF notch filters, dial calibration, HW32A external VFO, 6M converter, feedline info, rf z-bridge, fm mobile hints, umbrella ant, 432-er tx (part 1), pwr supply tricks with diodes, transistor keyer, transistor bias design, xtal vhf sign gen, electronic variac, SB33 mods, extra class study (part 10), SB34 linear improvements.

DEC 69. Transistor-diode checker, dummy load/attenuator, tuned filter chokes, bandswitching Swan 250 & TV-2, 88mh selectivity, match exercizes, rtl xtal calibrator, transistor pa design, hv mobile p.s., 1-10 gHz freqmeter, CB rig on 6M, extra license study (part 11), 1970 buyer's guide.

JAN 70. Transceiver accessory unit, bench power supply, SSTV color method, base-tuned center-loaded ant, 6M bandpass filter, extra license study (part 12, rectifier diode usage, facsimile info.

FEB 70. 18-inch 15M dipole, 6M converter, high-density pc board, camper-mobile hints, 2M freq synthesizer, encoding/decoding for repeaters, DX-35 mods, panoramic vhf rx, variable-Z HF mobile mount, extra license study (part 13), linear IC info, qrp 40M tx, IC Q-multiplier.

MAR 70. Gdo applications, charger for drycells, FM freq meter, pc board construction, ham fm standards, cheap rf wattmeter, multifreq fm osc, "IF" system modules (part 1), Six-er mods, gdo dip lite, Motorola 41V conversion, cw monitor, buying surplus logic, SSQ-23A sonobuoy conversion, GRC-9 rx/tx conversion, extra class study (part 14), intro to vhf fm.

APR 70. Noise blanker, 2M hotcarrier diode converter, repeater controller, understanding COR repeater, 7/8-wave 2M ant, extra class study (part 15), inexpensive semiconductors, removating surplus meters, linear amp bias regulator, hi performance if amp & agc system, SSB bfo for shortwave radio, vacuum tube load box, general fm dope & repeater guide, maggering your ant.

MAY 70. Comments on "fm docket" #18803, future of cw, fm-am rx aligner, 5/8 wave verticals, using 2M intelligently, auto burglar alarms, pwr supplies from surplus components, "IF" system modules (part 2), vhf FET preamps, educated "idiot" lites, postage stamp 6M tx, extra class study (part 16), Bishop IFNL, low-band police monitor, mobile cw tx, Wichita auto-patch.

JUNE 70. DDRR ant, vfo circuit, remote SWR indicator, indoor hf vertical, two rx on one antenna, environment & coax loss, 2 el trap verticals, buying surplus, two 40M qrp tx, 21dB 2M beam, extra class study (part 17).

DEC 70. Solid-state vhf exciter, delta-fre control for SSB, 2M transistor FM tx, HW100 offset tuning, "little gate" dipper, 3-500Z hf linear, general class study (part 5), "transi-test" (no good – errors!), transistor p.s. current limiter.

JAN 71. Split fones for dxing, Heath Ten-er mods, cw duty cycle, repeater zero-beater, HEP IC projects, 10-15-20M parabolic ideas, lightning protection, IC rx accessory, attic ants, double-balanced mixers, permanent marker tool, ham license study questions.

FEB 71. Metal locator, varactor theory, AFSK unit, SSTV patch box, ATV hints, RTTY tuning indicator, tone encoder/decoder, 220 MHz converter, SSTV magnetic deflection, IC code osc, 6M tx beeper, general class study (part 6), RTTY intro, perf-board terminal, low-ohmmeter.

MAR 71. IC audio filter, IC 6M converter, trap vertical ideas, digi counter info, surplus equipment identification, hf linear, simple fone patch, repeater audio mixer, digi RTTY accessories, coathanger gndplane, general class study (part 7).

APR 71. Intro to fm, noise blanker, repeater problems, Motorola HT [illegible] crowave repeater linking, di [illegible] tuneable 2M fm rx/tx, repe [illegible], fm marketplace, meter ev [illegible] ctor modulator, simple sig gen, touc [illegible] hookup, hf preselector, 10M 12W tx.

SOLD OUT

MAY 71. 75M mobile whip, 2M preamp, transistor amp design, 10M dsb tx, portable fm transceiver directory, audio compressor-clipper, transistor LM freqmeter, 450 MHz link tx, simple af filter, 1-tube 2M transceiver, surplus 2M power amp, general class study (part 8).

JUNE 71. 2M beam experiments, 3 el 2M quad, multi-band dipole patterns, weather balloon vertical, pocket-pager squelch, two-er vfo, tuning mobile whips, transistor pwr supply, capacity decade box, 40M gain ant, general class study (part 9).

JULY 71. IC audio processor, audio sig gen, cw filter, 2M fm osc, 2M collinear vertical, FM supplier directory, Motorola G-strip conversion, transistor beta tester, general class study (part 10).

AUG 71. Ham facsimile (part 1), 500 Watt linear, dimensions for July collinear, 4-tube 80/40 station, vfo digi readout, Jupiter on 15M, general class study (part 11), pink ticket wavemeter.

SEPT 71. Transformerless power supplies, solid state tv camera, IC substitution, two rf wattmeters, IC compressor-agc, multichannel HT-200, ham facsimile (part 2), causes of manmade noise, vfo with tracking mixer, general class study (part 12), transistor heatsinking, IC pulse gen, fone patch isolation, hcd wattmeters.

OCT 71. Emergency repeater cor, transceiver power supply, predicting meteor showers, digi switching, reverse-current battery charger, passive repeaters, earth grounds, audio "tailoring" filters, Swan 350 mods.

NOV 71. 3-el 75M beam, motor-tuned gnd plane, 2M gain vertical, transistor biasing, split-site repeater, fox-hunting, audio filter, transistor/diode tester, xtal tester, 6M kw amp, 10-15-20M quad, transistor pi-net final, ant feedline, communications dbs, 2300 MHz exciter.

AUG 72. SSTV intro, speech processor, fm repeater info, test probe construction, GE progline ac supply, 432 rf testing, preamp-compressor, Six-er mods, fone patch, Two-er info, solar info, SCR regulator for HVPS, "ideal" xtal osc, fm rx adaptor, auto theft alarm.

SEPT 72. Plumbicon tv camera, WWVB 60 kHz rx, cigartube sig gen, cw active filter, rf testing at 1296-3500 GHz, balun ant feed, transistor power supply, IC 6M rx, IC fm/am detector (part 2), active filter design (part 3), K2OAW freq counter (part 3), 2M freq synthesizer (part 1).

OCT 72. Corrections for Aug. fm rx adaptor, 2M freq synthesizer (part 2), 6M transistor vfo, nano-ampere meter, time-freq measurement (part 1), active filter design (part 4), repeater timer, extra-class Q&A (part 3), balloon vertical, ID gen, time delay relay, 432 filter ideas, DC-AC inverter, hc-diode converter, rtl decade and nixie driver, plus-minus supply for ICs.

NOV 72. Hf transistor power amps, RTTY selcal, IC trf rx, transistor keyer, emergency power, 220 MHz preamp, double-delta ant, simple converter using modules, hf RF tester, "lumped line" osc, 2M freq synthesizer (part 3), K2OAW counter errata, 2M preamp, extra class Q&A (part 4), hi-Z voltmeter, Nikola Tesla story, vhf swr meter, transistor regen rx, 432 SSB transverter, AC arc welder, intro to computers, hybrid am modulator, HR10 rx mods, 10M transistor am tx, 40M gndplane, IC logic demonstrator, overload protection, if/rf sweep generator, digi freq counter, aural tx tuning.

DEC 72. SSTV scope analyzer, 2M fm rx, tone burst encoder and decoder, universal if amp, autopatch hookup, LM380N info, voltage variable cap info, 2M 18 watt amp, SSB modulation monitor, xtal freq/activity meter, 10A var. dc supply, transmission line uses, radio astronomy, inductance meter, 75 to 20M transverter, LED info, 40M preamp, transistor vfo, 1972 index, 2M preamp.

JAN 73. HT-220 touchtone, 3-el 20M yagi, 50 MHz freq counter, speech processor, 2-tone gen, fm test set, tilt-over tower, 6M converter using modules, tuneable af filter, six band linear, 10M IF tuner, diode noise limiter, cw/ssb agc, HW22a transceiver 40M mod, HAL ID-1 mod.

FEB 73. CW id gen, tone operated relay, toroidal quadrature ant, active filter, time freq measurement (part 2), repeater timing control, SSTV circuits (part 1), 2M converter using modules, multifunction metering, FET biasing, freq counter preamp, TR22 hi-power mod, transistor rf power amps (part 1), light bulb rf power indicators, 75A4 filters, capacitance measurement, Gonset 201 mod, world time info.

APR 73. FM deviation meter, 2M FET preamp, two 2M power amps, repeater control (part 1), repeater licensing, European 2M fm, fm scanner adaptor, RCA CMU15 mods, lightning detector, cb alignment gadget, transistor rf power amps (part 2), repeater economics.

JUNE 73. 220 MHz sig gen, uhf power meter, repeater licensing info, RTTY autoswitch, 40M hybrid vfo tx, ant polar mount, 10-15-20M quad, K2OAW counter mods, double coax ant, ham summer job, tone decoder, field strength meter, nicad battery pack, ohm meter, FCC regs (part 1).

AUG 73. Log-periodics (part 1), tone burst gen, rf power amp design, transistor radio intercom, 160M ant, SSTV monitor, low cost freq counter, VOM design, qrp 40M tx, 432 MHz exciter, fm audio processing, FCC regs (part 3).

SEPT 73. Repeater control system, log-periodics (part 2), 2M rx calibrator, PLL ic applications, TT pad hookup, Heath HW7 "s" meter, Oscar-6 doppler, 2M coaxial ant, 2M converter, IC keyer, measure ant Z, FCC regs (part 4).

OCT 73. GE Pocketmate mods, microwave freq measurement, CA3102E 2M frontend, 2 kw hf linear, rf wattmeter, meter repair, 80/40 dipole, IC "hi" gen, vhf freq multiplier, FCC regs (part 5).

NOV 73. 450 MHz exciter, intro to ATV circuits, nicad voltage monitor, autopatch connections, IC meter amplifier, TR22 ac supply, indoor vertical, IC af filter, momentary power failure protection, 160M ant acoupler, Motorola HT info, SSTV-ISB, Class-B af amp, FCC regs (part 6).

DEC 73. Code speed display, 2M kw amp, IC keyer, 8038 waveform gen, helical resonator design, sensitive rf voltmeter, proximity control switch, IC tester, sequential tone decoder, 2M portable beam, electronic calculator math, cw filter design, FCC regs (part 7).

FEB 74. SSTV monitor info, IC audio amps, scope sweep gen, 15/20M vertical, telephone line control system, pc board construction, var-Q af filter, blown-fuse indicator, 40m cw stn with Ten-Tec modules, simple preamp compressor, single IC rx, "432-er" final assembly, transistor keying circuit, 7-segment readout with nixie driver.

APR 74. Vox for repeaters, tone operated relay, hf transverter, 10 to 2m tx converter, remote control panel for scanner, RCA fm tx tuning, subaudible tone gen, FCC regs (part 9), Repeater Atlas.

MAY 74. Cd car ignition, audio compressor info, interference suppression for boats, auto burglar alarms, 2m ic preamp, 10m fet converter.

JULY 74. 4-1000A linear, universal freq gen, universal afsk gen, 555 IC timer, 80M phased array, 135 kHz 432 MHz preamps, 10M qrp am tx, 3000 vdc supply, how to read diagrams.

AUG 74. Toroidal directional wattmeters, 450 MHz FET preamp, use gdo to find "c", Trimline tt pad hookup, R390 & R392 rx mods, tracking cw filter, aural voltmeter, universal regulated supply, sstv scan converter, ttl logic problems, ID timer.

SEPT 74. MOSKEY electronic keyer (part 1), wx warning system, Heath 10-103 scope mods, qrp 6M am tx, rf speech clipper, audio noise limiter, wx satellite on SSTV monitor, universal IC tester, miniature rig construction, tower construction, infinite rf attenuator, electronic

(More)

Since there's little to get stale in back issues of 73 (our magazine is not padded .... like others ... with reams of activity reports), you'll have a fantastic time reading them. Most of the articles are still exciting to read ... and old editorials are even more fun for most of the dire predictions by Green have now come to pass. Incentive licensing was every bit the debacle he predicted ... and more. You'll really get a kick out of the back issues.

photo-flash ideas, IC "select o-ject."

OCT 74. Microtransistor circuits, synthesizen HT-220 (part 1), repeater government, regulated 5 vdc supply, fm selcal, removeable mobile ants, Motorola metering, 2M vertical collinear, Motorola model code, 2M coaxial dipole, 1.6 MHz if strip, MOSKEY electronic keyer (part 2), carbon mike circuit, hi power lo-pass filter, 6M preamp, 3 wire dipole, ATV sync gen, NCX-5 mods, mobile whip for apartment dwellers, sstv auto vertical trig.

NOV 74. K2OAW counter update, regulated 5 vdc supply, wind direction indicator, synthesized HT-220 (part 2), 20M 3-el beam, autopatch pad hookups, double-stub ant match, novice class instruction, digi swr meter (part 1), 6M converter (1.6 MHz if), "C-bridge," MOSKEY electronic keyer (part 3), Aug. sstv scan converter errata, repeater off-freq indicator.

DEC 74. Care of nicads, wind speed/direction indicator, wx satellite video converter, electronic keyer, hints for novices, unknown meter scales, SSTV tape ideas. TTL logic probe, public service band converter, tuned-diode test receivers, digi swr meter (part 2), telephone pole beam support, rhombic antennas, 1974 Index

FEB 75. Heath HO-10 scope mod for SSTV, electronic keyer, digital satellite orbital timer, Oscar-7 operation, satellite orbital prediction, Heath SB-102 mods, comparing FM & AM, repeater engineering, Robot 80-A sstv camera mod, neutralizing Heath SB-110A, "Bounceless" IC switch, tape keyer for cw tx.

APR 75. $50 walky for 2M, 2M scanning synthesizer, 88 mH toroid info, 8-function repeater controller, nicad battery precautions, TR22C preamp, telephone attachment regs, Guide to 2M Hand-held Transceivers, 2M 7-el beam, basic telephone systems (part 1), 10 min ID timer, modified hf Hustler mobile ant for 2M, 15M quad modified for 20M, 2M collinear beam, R-11A surplus rx conversion, 5/16-wave 2M ant, Hallicrafters SX-111 rx mods, 160M cw tx.

AUG 75. 146/432 MHz Helical ants (part 2), 10 min ID timer, digi swr computer (part 1), debugging rf feedback, DVM byer's guide, wx satellite monitor, cmos "accu-keyer," pc board method, sweep-tube final precautions, compact multiband dipoles, small digital clock, accessory vfo for hf transceiver, modern non-Morse codes, multi-function gen, 2M scanning synthesizer errata, KP-202 walky charger, 10M multi-element beam.

SEPT 75. Calculating freq counter, wx satellite FAX system (part 1), IC millivoltmeter, three-button TT decoder, troubleshooting sstv pix, 40M dx ants, 146/432 MHz helical ants (conclusion), digi swr computer (conclusion), reed relay for cw bk-in, NE555 preset timer, power-failure alarm, portable qrp rig power unit, precision 10 vdc reference standard, 135 kHz if strip, telephone handsets with fm transceivers, Motorola T-44 tx mod for ATV, 0-60 MHz synthesizer (part 10, ham radio PR).

OCT 75. A deluxe TTY keyboard (part 1), Op Amps: a basic primer, an introduction to microprocessors, 2m Synthesizer (conclusion), Satellite Fax System (conclusion), regulated supplies (dispelling the mystery), Digital Logic made simple, FCC interview, a contest uP system, digital clock time bases, the operating desk, QRP 432, ham PR.

NOV-DEC 75. Blockbuster double issue! Flip-flops exposed, breakthrough in fast scan ATV, strobing displays is cool, the tuned lunch box (antenna tuner for HF transceivers), a deluxe TTY keyboard (part 2), the 127' rotating mast, less than $100 multi-purpose scope for your shack (part 1), predicting third order intermod, feedline primer, QRMing the Third Reich, why tubes haven't died, instant circuits — build your own IC test rig, the K2OAW synthesizer PROM-oted, a ham's intro to microprocessing, Ground Fault Interrupter (a keep alive circuit for yourself), a $1 strip chart recorder, an even simpler clock osc., the Fun City surplus scene, updating the Heath IB-1101 counter, 256 pages!

JAN 76. Clocks – Really Simplified, De-Strain your Ham—M, An Automatic Dialer for the Deluxe Mobile, Zapping Dead Nicads to Life, The Computer QSO Machine, $50 Self-Powered Counter, Save Money on Coax, How to Pass Exams, Using a Bargain Surplus Keyboard, Improve Your SSTV with the FRAMER, and more. The first *73* in new large format! (Includes 1975 Index to *73*).

FEB 76. Build a Starfleet Communicator – Trekkies Special, Synthesized IC Frequency Standard, You Can Make Photo PC Boards, How's Your Speech Quality?, ASCII to Baudot Converter, RTTY Autocall – the Digital Way, Improving the FT-101, Night DXing on 10 and 15m, Really Soup Up Your 2m Receiver, Put Your SB-10 on 160m.

MAR 76. Special Surplus Issue – Tunable FM Receiver Strips, Surplus Circuit Boards – A Gold Mine of Parts, Space Age Junque, A PC Board Bonanza, Government Surplus: Is It All Gone?, Stereo – A New Type of CW Filter, Build This Exciting New TVT, The Smart Power Supply, How to Use Surplus Fets.

APR 76. Special FM Issue – A Programm[illegible], Put That AM Rig on FM, A COR for your Repe[illegible] Amplifier, Build a 220 MHz Repeater [illegible] Your Regency, Long Distance C[illegible] TT Decoder, One IC Tone Burster, Th[illegible]coder, A Versatile TTY Generator, The PLL – Exp[illegible], TR-22 Tips, Computers Are Ridiculously Simple.

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MAY 76. Special Antenna Issue – The Magnificent Seven Microhelix, An Allband Inverted Vee, Closed Loop Antenna Tuning, The 75-80m Broadbander, The Magic of a Matchmaker, How to Cloak Your Antenna, 40m DXing – City Style, The Secret 2m Mobile Antenna, An Inverted Vee for 160/80m, The Dipole Dangler, Amateur Weather Satellite Reception, Scan Your HR212, A Very Cheap I/O – the MOdel 15, Code Converter Using PROMs, A Nifty Cassette-Computer System, The Ins and Outs of TTL, Build a CW Memory, 5/8 Wave Power for Your HT, 555 Timer Sweep Circuit for SSTV, AM is Not Dead – It Never Existed at All, Computer Languages – Simplified.

JUN 76. VHF Special – Super COR – Digital of Course!, Touchtone Decoder – Using a Calculator Readout, Simple Amateur TV Transmitter, Amateur TV Receiving System, Mobile Autodialer, Autocall '76 – Using a Touchtone Decoder, Build This Lab Type Bridge – and Measure Transformer Impedances, How Those Triangle Things Work – a Sort of Op Amp Handbook, Those Exciting Memory Chips – RAMs, ROMs, PROMs, etc., ASCII/Baudot with a PROM – for Ribbonless RTTY on Computers, Aim Your Beam Right – With a Programmable Calculator.

JUL 76. Perfect CW – Drive 'em Crazy with the Keycoder I, The Mini-Mite Allband QRP Rig – A Mighty 7 Watts, A Fun Counter Project – Under $50, Build a FAX from Scratch – Then Get Satellite Pictures and Other Things, Der Repeatermeister – Repeater Control with ID, The Giant Nixie Clock, Creative SSTV Programming, CW Regenerator/Processor, What's Up on 156 MHz?, TT Pad for the Wilson HT, Power Supply Testing – To Save Your Digital Circuits, A RTTY/Computer Display Unit, Your Computer Can Talk Morse, Gain for Your HT – a Half Wave Whip, The Super Transmatch, Simple VHF Monitor.

AUG 76. How Do You Use ICs? – Fundamentals, Surprising Miniature Low Band Antenna – the DDRR (Part I), MINI-MOS – the Best Keyer Yet?, The Skinflint's Delight Breadboard – Cheap Imitation of a Commercial IC DIP Board, More PLL Magic, The Logic Grabber – Selected Interval Logic Tracer, Global Calculations for the DXer – Using a Hand Calculator, Instant Counter Calibration – Using Your TV Set, Simple 450 MHz Rig – Go ATV With a $42.50 Module, The First Computer Controlled Ham Station – Grand Prize Winner, The Which Chip Dilemma! – 4, 8, 12, or 16 bits: pros and cons, Meaningful Conversations with your Computer – What All These Mysterious Languages Are All About, A Baudot Monitor/Editor System, A Logic Probe You Can Hear, Satellite Orbit Predicting – Using a Pocket Calculator, FSK with the SB-401, Build the Safari RTTY Terminal, El Cheapo Signal Tracer – Test Gear for the Cheapskate.

SEP 76. The Surprising DDRR Low Noise Antenna (part II), Ultrasimple Regulation with New IC – Power Supply Design Greatly Simplified, Can an Indoor Antenna Work – Making the Best Out of a Bad Bargain, Inexpensive 12 Volts for Your Base Station, A Test Lab Bonanza – Using a Transistor Radio, Protect Your VHF Converter – Novel Antenna Relay, Ridiculously Simple RTTY System, How to Catch a CBer, A 450 MHz Transceiver for Under $130, Space Age Junque II, PROM Memory Revisited, Eight Trace Scope Adapter, The PROM Zapper, Sneaky Baudot – With an ASCII Keyboard!, Simple Graphics Terminal – Using surplus, Counters are Not Magic – They're Simple.

OCT 76. Build a Weird 2 Band Mobile Antenna, Build a Counter for Your Receiver, How do You Use ICs? (part II), QRP Fun on 40 and 80 – Have a Real Ball with Just 5 Watts, The Hybrid Quad – Low Windload, Expense, Hassle!, Frequency Detector for Your Counter, Programmable CW ID Unit – for RTTY, Repeaters, Mobile, etc., New ICs for the Counter Culture – Simpler Counters with Less Used Power, Is My Rig Working or Not? – Build an Effective Radiated Field Meter and Know!, Quickie Collinears for 15 and 10 – a Satisfaction Guaranteed, Build a Super Standard – Goes Right Down to 1 Hz, The Incredible Lambda Diode, Mechanical RTTY Buffer, Have You Used a Triac Yet?, How to Interface a Clock Chip – Baudot, BCD, or ASCII Conversion, A TTL Tester – Great for Unmarked Bargain ICs, The New Ham Programmer – Making Those Confounded uPs Work, BASIC? What's That? – the Basics of BASIC, The Soft Art of Programming (part I).

NOV 76. Blockbuster 288 pg issue! Cordless Iron Tips, Bicycle Mobile, Build a Simple Lab Scope – Costs Less Than $70!, Get on Six with Surplus – The El Cheapo RT-70 is a Natural, The Beam Saver – Rotor Memory System, Updated Universal Frequency Generator, The Shirt Pocket Touchtone, Liquid Crystal Display Guide, Self-Powered Mike Preamp, The Wind Counter, The 838 is Not Dead!, The Amazing Inverted L – Antenna for 20, 40, and 80m, Battery Chargers Exposed, How Do You Use ICs (part III), Thirty Years of Ham RTTY, Big Noise Burglar Alarm, Dandy Digital Dial Decoder, Weather Satellite Display Control, Ham Time-Sharing is Here for You!, The Soft Art of Programming (part II), OSCAR Orbits on Your Altair, ASCII/Baudot Converter for Your TVT, The Smoke Tester – Power Supply Tester, The Man Who Invented AC – Tesla, the Greatest Pioneer of Them All!, Baudot to ASCII – You Want to Learn Programming?, Baudot and BASIC – an Interpreter for a Baudot Computer, Toward a More Perfect Touchtone Decoder, Using a Wireless Broadcaster, The Quiet Spy – Amateur Uncovers Spy Ring in the US!, The Benefits of Sidetone Monitoring – And How to Do It.

DEC 76. Go Tone for Ten – Simple Subaudible Encoder, World's Simplest Five Band Receiver?, How Do You Use ICs? (part IV), A Super Cheapo CW IDer, The ZF Special Antenna, CT7001 Clockbuster, Saving a CBer, A Ham's Computer, What's All This LSI Bunk? – an Ostrich's Eye View of the Microprocessor, The Soft Art of Programming (part III), Put Snap into Your SSTV Pictures – Using a $20 Frequency Standard, What's all This Wire-Wrap Stuff? – Talk About Cold Solder Joints!, Exploding the Power Myth, Exploding the SWR Myth, The IC-22 Walkie – Portablization with Nicads, Watch DX with a Spectrum Analyzer, DXing with a Weather Map.

HOLIDAY 76. 55 article issue! An Inexpensive 400 Watt HF amplifier, How Do You Use ICs? (part V), Mobile Smokey Detector – 10.5 GHz: Use It or Lose It!, Add RIT to Your Transceiver, DXpedition: Memories for a Lifetime – Reflections of HK1TL, Design Your Own QRP Dummy Load, Failsafe Super Charger – Multi-rate too!, The Amazing 18" Antenna for 160m, Replacing the Knife Switch – Simple TR System for the Novice, Now You Can Synthesize – the VHF Engineering Approach to 2m Happiness, Hutchinson's Remedy – the Chirpless CW Machine, The Mod Squad Does the Pocket Scanner – Radio Shack Pro-4 Update, TR-22 Mod Squad, What Computers Can and Can't Do, A Ham Shack File Handler – Program in BASIC for QSLs, Repeaters, etc., Print Your Own Logbook – On Your Nearest Computer, Sharing Your HT, Cash In on the CB – Installation for Fun and Profit, Tuning Those Big Antenna Coils, The 2m Mod Squad Tackles the Weather Radio – and Wins!, Homming by Laser, A 80 Foot Antenna on a 20 Foot Lot – Solving a 40m Novice problem, Dual Voltage Power Supply, An Autopatch Busy Signal, Inside the GLB – a Gutsy Look at a Synthesizer, How to Bug an Automatic Keyer, A 450 Duplexer – That Fits in Your Car, Will Silver-Zinc Replace the Nicad?

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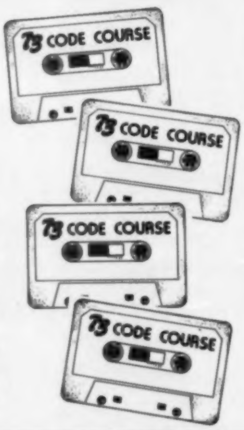

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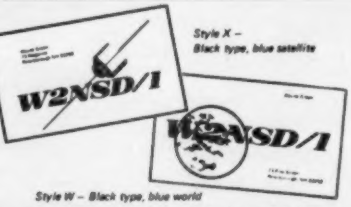

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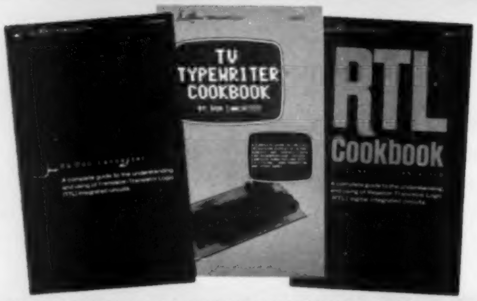

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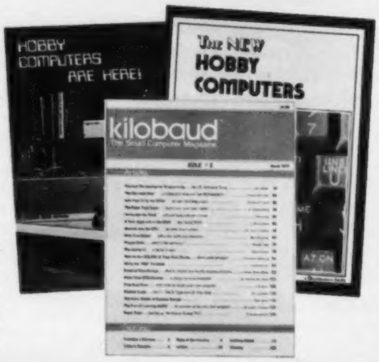

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